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HICKIN (N. E.). **Methods used in rearing small Insects infesting Stored Food Products.**—*Proc. R. ent. Soc. Lond.* (A) **16** pt. 4-6 pp. 35-38, 4 figs., 3 refs. London, 1941.

Descriptions are given of cages made of glass tubing in which Ptinid beetles have been successfully reared in large numbers, of humidity chambers in which the cages were kept, and of a sieve used to separate young larvae and eggs, together with a mechanical device to operate it.

CLARK (J.). **Notes on the Argentine Ant and other exotic Ants introduced into Australia.**—*Mem. nat. Mus. Vict.* no. 12 pp. 59-70, 3 figs., 4 refs. Melbourne, 1941.

Iridomyrmex humilis, Mayr, which was first recorded in the district of Melbourne in September 1939 [cf. *R.A.E.*, A **28** 443] but had probably been present for some years previously, now occurs at a number of widely separated points in this neighbourhood in comparatively small but rapidly developing infestations, and drastic measures will be necessary to exterminate the nests already in existence and prevent the dispersion of the ant, which has caused much annoyance in houses [cf. **29** 332] and may become a serious pest to farmers, fruit-growers, poultry-men and bee-keepers. A study of its distribution round Melbourne suggests that it spreads by division of a large nest, the workers and females travelling considerable distances; it is dispersed by the carriage of plants, firewood and similar material. Nests have been found in the ground, at the foot of fence posts, under bark or in holes in trees, in the brickwork of houses and walls and in flower-pots; one nest approximately 180 ft. long by a fence contained 37 females in a section about 18 ins. long and 4 ins. wide.

Detailed descriptions and figures are given of the worker, female and male of *I. humilis*, together with lists of the ants that have been introduced into Australia, showing their present known distribution there and the probable country of their origin, and of ants that are not present in the area invaded by *I. humilis* but occur in the immediate neighbourhood; four indigenous species of *Iridomyrmex* that were common in this area have been displaced.

SWAN (D. C.). **The Control of Ants.**—*J. Dep. Agric. S. Aust.* **44** no. 7 pp. 373-375, 3 refs. Adelaide, 1941.

The principal ants that are pests in houses in South Australia are *Iridomyrmex rufoniger*, Lowne, which is the commonest species, *Monomorium pharaonis*, L., which usually nests in the house itself, and, occasionally, *Camponotus nigriceps*, F. Sm. (*consobrinus*, F. Sm.) var. *obniger*, Forel. *I. detectus*, F. Sm., is troublesome in gardens as it makes its large nests in pathways and hard tennis courts. The measures recommended for the control of these ants comprise fumigation of the nests with carbon bisulphide [cf. *R.A.E.*, A **28** 27] and the use of various poison baits. A bait recommended for ants that feed on sugary foods, as all these species do, is prepared by boiling 3 lb. sugar, 2 gm. tartaric acid and 3 gm. sodium benzoate in 3 pints water for 30 minutes, dissolving 5 gm. sodium arsenite in $\frac{1}{2}$ pint hot water, mixing the two solutions when cool and then stirring in $\frac{1}{2}$ lb. honey. The syrup should be placed in suitable containers where the ants are troublesome. *I. detectus* feeds also on meat and may be poisoned by the addition of

tartar emetic to meat grease. It is suggested that a careful watch should be kept for the Argentine ant, *Iridomyrmex humilis*, Mayr, which is now well established in Melbourne [see preceding abstract].

SWAN (D. C.). **The Control of Silverfish.**—*J. Dep. Agric. S. Aust.* **44** no. 8 pp. 420–422, 1 fig., 12 refs. Adelaide, 1941.

The only species of silverfish that occurs in houses in South Australia is *Ctenolepisma longicaudata*, Escherich, though *Lepisma saccharina*, L., has been observed once in a flour mill, and *Thermobia domestica*, Pack., in a bakehouse. The bionomics of *C. longicaudata* are very briefly discussed [cf. *R.A.E.*, A **29** 55], and control measures recommended during recent years against all three species are reviewed. A modification of the baits previously recommended against *Ctenolepisma* [**25** 222; **27** 510] was used to control it in the building of the Waite Agricultural Research Institute. Sodium fluosilicate, which is soluble in water at the concentration recommended, was substituted for the more expensive barium fluosilicate, as the latter is heavy and insoluble and so tends to settle out of the paste, though the insolubility of the barium salt has been thought to increase its palatability to silverfish. The formula used was 4 oz. plain wheat flour, 4 oz. sugar, $\frac{1}{2}$ oz. salt, 1 oz. finely powdered sodium fluosilicate, $\frac{1}{2}$ oz. gelatine and 3 pints water. The flour is made into a smooth paste with part of the water (cold), after which the rest of the water is added, the mixture heated to form a paste, and the other ingredients stirred in. The paste is applied hot to thin cards, which should remain effective as long as any of the film remains. At least one card was placed in every drawer and cupboard shelf in the building; several months later silverfish had become rare, and they have remained so in the succeeding two years.

EVANS (J. W.). **Some Queensland Leaf-hoppers (Jassoidea, Homoptera) that attack Lucerne.**—*Proc. roy. Soc. Qd* **52** pt. 1 pp. 10–13, 19 figs., 2 refs. Brisbane, 1941.

Short descriptions are given of eight species of Jassids found on lucerne in Queensland, of which five are new. These are *Eurinoscopus punctatus*, *Macrosteles (Cicadula) bimaculatus*, *Empoasca athertoni*, *E. alfalfae* and *Erythroneura sativae*. The others comprise *Thamnottetix argentata*, Evans, which is common on a variety of weeds in all States of eastern Australia and has been recorded from tobacco in New South Wales, *Empoasca terrae-reginae*, Paoli, and *Nehela torrida*, Evans. The last-named is transferred from the genus *Austrogallia*, of which it was described as the genotype, and which thus becomes a synonym of *Nehela*. A key is given to the species dealt with.

HARDY (G. H.). **Aphididae in Australia. II. Subtribe Pentaloniina.**—*Proc. roy. Soc. Qd* **52** pt. 1 pp. 36–40, 8 refs. Brisbane, 1941.

In this continued paper [cf. *R.A.E.*, A **20** 556], the author recognises only three, very doubtfully distinct, genera of the subtribe Pentaloniina, viz., *Pentalonia*, *Idiopterus (Micromyzus)* and *Microparsus*. *Micromyzus* cannot be separated from *Idiopterus* [cf. **24** 247] because its genotype, *M. nigrum*, v.d.G., is a synonym of *I. nephrolepidis*, Davis, the type of *Idiopterus*. *Microparsus* is a rare

monotypical North American genus that was erected for *M. variabilis*, Patch. Australian species of the subtribe are *P. nigronervosa*, Coq., (the only member of its genus), *I. nephrolepidis* and *I. violae*, Perg. A key to these three species and lists of their synonyms are given, followed by notes on their biology in Brisbane.

New colonies of the banana aphid, *P. nigronervosa*, are established by alate migrants reared after 7–10 generations of apterae; migrants produced before the normal time fail to initiate new colonies or do so to a very limited extent. There are four periods of the year when migrants occur on a sufficiently large scale to be apparent. Small numbers are produced in some colonies in late August or September, and larger numbers in others in November, and the colonies founded by the September migrants give rise to alates in December–January; in each case the colony dies out after the production of migrants, even if it produces them in early spring. The colonies founded by the November migrants produce considerable numbers of alates in March and April; these appear suddenly and swarm over many plants, chiefly monocotyledons, setting up new colonies. The country of origin of *I. nephrolepidis* is unknown, but it now occurs in small numbers throughout most parts of the world, being transported with ferns and surviving in temperate regions in greenhouses. It has been observed only in the autumn and winter months in Brisbane, and the production of alates is followed by the extinction of the colony. This is not solely due to attack by predators and parasites, though they are plentiful, as colonies protected from them failed to survive the production of more than a few successive generations of migrants, dying out in about 12 weeks. *I. violae* has been recorded from many parts of the world, on cultivated violets only, but is usually uncommon. It was not found on a native violet that grows very densely in an area about 15 miles from Brisbane, where it has been observed only during the winter. Alates seem to be reared continuously for a short period in June, and the colonies entirely disappear in August. Apparently not more than two apterous generations occur between alate ones. No parasites or predators were found.

VEITCH (R.). **The Lantana Leaf Bug in Queensland.**—*Qd agric. J.* 55 pt. 4 pp. 270–272. Brisbane, 1941.

An account is given of the introduction into Australia from Fiji in 1936 of *Teleonemia scrupulosa*, Stål, for liberation against the noxious weed, *Lantana [camara]* and of the release and subsequent successful colonization of this Tingid in Queensland, north of Townsville [cf. *R.A.E.*, A 28 317; 29 467]. During the winter of 1940, *Lantana* was defoliated over large areas in northern Queensland, particularly on the coast; occasional plants were killed, but in most cases regrowth occurred in the spring. Such regrowth has been freely attacked by the Tingid, and extensive defoliation has again taken place. It is too early to state to what extent the plants are likely to be killed, but the prospects in this district are decidedly promising.

The results in central and southern Queensland have been less favourable. A colony liberated in October 1937 in the district of Rockhampton became established [cf. 27 603] and was reinforced by three more during the subsequent 12 months, but the bug has not become abundant there and has rarely caused injury to *Lantana* comparable with that in northern Queensland. Several other colonies

were liberated in the Rockhampton district prior to the summer of 1940-41, but none of these appears to be any more promising than the original one. The bug was released at several centres between Townsville and Maryborough in the summer of 1940-41, and was known to be breeding actively, though on a small scale, at the time of writing.

In southern Queensland, a colony was liberated at Glenapp, near the New South Wales border, in February 1940, and investigations in the following December showed that the bug had survived the winter. Another colony was released near Mount Perry in the autumn of 1940, but it is not known whether it survived the heavy winter frosts. Further colonies, obtained from northern Queensland, were liberated in the summer of 1940-41, mainly for purposes of observation, at selected places between Maryborough and the southern border. The cold dry conditions that prevail in winter and spring in southern and also central Queensland are unfavourable to the establishment of the bug.

Insect Pests.—*Agric. Gaz. N.S.W.* **52** pt. 5 pp. 277-280, 6 figs. Sydney, 1941.

This part of a series on insect pests in New South Wales [*cf. R.A.E., A 30 100*] includes notes on *Listroderes obliquus*, Gylh., the larvae of which attack winter vegetables, particularly turnips, carrots, beet and lettuce. The eggs of this weevil are deposited on the soil or in the crowns of the plants in autumn and throughout the winter. The larvae hatch in 2-4 weeks and pupate in the soil after 4-6 weeks, giving rise to adults in spring. These feed by night on potatoes and tomatoes until late November and then aestivate in the soil until the advent of cool autumn weather. The larvae can be controlled in winter and the adults in spring by dusts or sprays of lead arsenate, but if an arsenical is undesirable, as on lettuce, a dust of equal parts of pyrethrum and kaolin is effective. The weevil also breeds on various weeds and, as it does not migrate far, can be controlled by clean cultivation in winter. Infested land that is to be planted should be cleared and treated with a poison bait. Peas, beans, cucurbits or cereals, which are not attacked, should be used in rotations to free fields from infestation.

The Tetranychid mite, *Tenuipalpus californicus*, Banks, has several times been taken on hedges of privet (*Ligustrum*), and has been recorded from rhubarb, *Plantago* sp., grape vine, *Camellia* and azalea. Injury most frequently takes the form of a rusting of the leaf surface due to the destruction of the epidermal cells, while in grape bunches, discoloration of the cuticle of the stalks and pedicels is followed by the shrivelling of grapes near the apex of the bunch. Control measures have not been carried out on privet, but a single application of a spray of white oil (1 : 100) and nicotine sulphate (1 : 800) or two, at an interval of 3 weeks, of 2 lb. colloidal sulphur and 4 lb. soft soap in 100 gals. water have been found satisfactory on other plants.

ALLMAN (S. L.). **Control of Queensland Fruit Fly. Caged Tree Tests.**—*Agric. Gaz. N.S.W.* **52** pt. 5 pp. 281-282, 1 fig., 2 refs. Sydney, 1941.

The experiment described was carried out in 1941 under cage conditions in a peach orchard in New South Wales to compare the effectiveness against the Queensland fruit-fly [*Dacus ferrugineus tryoni*,

Frogg.] of the trap-bait of ammonia and vanilla essence and the foliage bait-sprays of sodium fluosilicate or tartar emetic and sugar that are prescribed for use against fruit-flies [cf. *R.A.E.*, A **29** 54-55]. *D. f. tryoni* requires special conditions for breeding in the laboratory [cf. **27** 345], and it was not known how it would react in the field cages. These were 10 ft. high, with bases 10 ft. square, and each enclosed one tree. On 14th January, 25 males and 25 females, all about a week old and therefore, according to laboratory experience, ready to produce fertile eggs [cf. **29** 55], were released in each cage. The temperature at the time was 70°F., the sky was overcast and light rain was falling. The bait-sprays were applied to four patches of foliage on two of the trees at the rate of $\frac{1}{2}$ pint per tree, and a baited trap was hung in the third tree. The fourth was left untreated. Oviposition in the fruit was not observed until six days after the introduction of the flies, and it was apparent that older flies should have been used to ensure earlier oviposition. Although weather conditions during the early part of the test were variable and generally unfavourable for fruit-fly activity, the later period showed that *D. f. tryoni* will breed readily in cages placed over trees.

Three days after release, no living flies could be seen in the cage that had received the tartar-emetic treatment and only a few in the one in which the other bait-spray had been applied; 16 flies had been caught in the trap, and there was apparently no mortality in the control. As heavy rain fell at this time, the bait-sprays were renewed at the end of 6 days and the trap was rebaited at the end of 7 days. At this time no living flies were observed in either of the bait-spray cages. The progressive totals of flies caught in the trap were 29, 38 and 43 in 7, 14 and 21 days, about half being females. No further flies were trapped or seen in this cage, so that the remainder had presumably died and been carried away by ants.

The percentages of fruits infested were 0 in the case of the bait-sprays, 1.3 in the cage containing the trap and 34.2 in the control. These percentages were lower than was expected, possibly owing to the use of young flies. On the basis of flies killed, the percentage of fruit infested and the time required to free the cages from flies, it is clear that a bait-spray protects the fruit more effectively than the trap. The period required for the spray to eliminate the flies is not unduly long, since the flies cannot oviposit for 7 days after emergence and those that ingest sub-lethal doses of poison lay sterile eggs [**29** 495].

LEVER (R. J. A. W.). *Entomological Notes*.—*Agric. J. Fiji* **12** no. 2 pp. 45-50, 22 refs. Suva, 1941.

In an attempt to control *Nezara viridula*, L., which has recently appeared in Fiji [*R.A.E.*, A **29** 170, 279], a shipment of eggs of this bug parasitised by *Microphanurus basalis*, Woll., was imported from New South Wales in March 1941. At the time of its arrival, hosts were scarce, owing to the destruction of the main food-plants (tomatos and beans) by a hurricane in February, but stocks of *M. basalis* were eventually reared. The duration of development [cf. **25** 737] varied from $8\frac{1}{2}$ to 11 days and averaged 10.4 in Fiji, where the average mean temperature for April during the previous five years was 79.6°F. Liberations of this Proctotrupid were made in four localities on Viti Levu. A consignment of the parasite was sent from Sydney to the

Solomon Islands in May 1940, and there it was found to prefer eggs of *Axiagastus cambelli*, Dist., to those of *Amblypelta cocophaga*, China, which is the more important pest of coconut [24 328].

In November, pods of *Cajanus cajan* damaged by the corn earworm [*Heliothis armigera*, Hb.] and containing seeds injured by *Bruchus chinensis*, L., were received from Lautoka [29 390, 496], where damage by the Bruchid was sufficient to check the cultivation of this crop. *B. chinensis* has also been recorded in Fiji from beans (*Phaseolus* spp.), cowpeas and *Cicer arietinum*. Suggested control measures include storing the seed in tanks or barrels under a 2-in. layer of thoroughly dry, fine, coral sand, which dries up the body fluids of the insect and checks development. *B. oblectus*, Say, was intercepted in beans from California and *B. maculatus*, F. (*quadrimaculatus*, F.) in *Crotalaria* pods from Florida.

In August 1940, larvae of *Cirphis unipuncta*, Haw., were observed feeding on unexpanded leaves of maize for the first time in Fiji, where they have previously attacked rice, Para grass [*Panicum barbinode*] and sugar-cane. Cocoons of the Braconid, *Apanteles ruficrus*, Hal. (*antipoda*, Ashm.), were observed on the leaf-sheaths of the maize; other local parasites are *A. samoanus*, Fullaway, *A. expulsus*, Turn., and the Tachinid, *Sturmia inconspicua*, Mg. (*bimaculata*, Htg.). Adults of *A. ruficrus* were sent to Hawaii for use against *H. armigera* [cf. 29 496]. In early May 1941, an outbreak of *C. unipuncta* occurred along the Rewa River, where rice was the principal crop attacked, and leaves of Para grass and sugar-cane were also damaged. This outbreak, like the previous ones on rice [27 213; 28 323], followed heavy rains.

Annual Report of the Department of Agriculture for the Year ending 30th June, 1940.—*New Guinea agric. Gaz.* 7 no. 2 pp. 77–116. Rabaul, 1941.

In the report of the entomologist (pp. 87–89), J. L. Froggatt deals largely with pests of coconut in the Territory of New Guinea. He states that the breeding of *Tetrastichus* (*Tetrastichodes*) *brontispae*, Ferrière, on pupae of *Brontispa longissima*, Gestro (*froggatti*, Sharp) and the distribution of parasitised pupae in the Districts of New Britain, New Ireland, Manus and Kieta were continued throughout the year [cf. *R.A.E.*, A 29 379]; mass liberation was carried out on young coconuts near Rabaul, and the Eulophid was recovered on several occasions from this area. The parasite bred from eggs of *B. longissima* collected during 1939 [*loc. cit.*] is *Trichogrammatoidea nana*, Zhnt.; eggs collected from an area in which it was prevalent were sent to the British Solomon Islands. Laboratory rearing and distribution of *Pleurotropis parvulus*, Ferrière [against *Promecotheca papuana*, Csiki] was discontinued towards the end of 1939, as it was well established in the areas of New Britain in which outbreaks of this Hispid have occurred [cf. 29 377]. The Dynastids, *Xylotrupes gideon*, L., and *Scapanes grossepunctatus*, Sternb., caused severe damage to coconut in many parts of the Rabaul-Kokopo district, especially where logs and stumps had been left to rot after clearing, and infestation by *Sexava* was reported in part of New Hanover and in Manus.

Spodoptera mauritia, Boisd., occurred in large numbers on couch grass [*Agropyrum repens*] near Rabaul; a Braconid of the genus *Microdus* was bred from the larvae and apparently gave considerable

control. Other pests recorded include *Dysdercus cruciatus*, Montr. (*papuensis*, Dist.) and an unidentified Pentatomid, which were found breeding on *Hibiscus tiliaceus* near Rabaul, and Eumolpids (*Rhyparida* spp.), which were observed feeding on the young leaves of cacao [cf. 27 544] and may damage the young tips if infestation is severe.

Brief notes on insect pests in other sections of the main report include a statement that banana fruits on a demonstration plantation were damaged by the Pyralid, *Nacoleia* (*Notarcha*) *octasema*, Meyr., which can be controlled by dusting pyrethrum powder under the bracts as soon as they lift, and that the introduced toad, *Bufo marinus*, continued to give complete control there of *Hippotion celerio*, L., on sweet potato [cf. 29 377]. Light infestations of *Promecotheca papuana* (*antiqua*, Weise) on coconut were observed in New Ireland, where this Hispid has not previously been recorded, and liberations of *Pleurotropis parvulus* were made in an attempt to control it. The parasite was later found to have become established and to be checking the Hispid.

FROGGATT (J. L.) & O'CONNOR (B. A.). **Insects associated with the Coco-nut Palm. Part II.**—*New Guinea agric. Gaz.* 7 no. 2 pp. 125–133, 6 refs. Rabaul, 1941.

This further paper on insects associated with coconut in the Territory of New Guinea [cf. R.A.E., A 29 379] is devoted to Hispids, those of importance being *Promecotheca papuana*, Csiki, and, occasionally, a species of *Brontispa*. The authors call this species *B. froggatti*, Sharp, since they do not agree with the view [26 499] that it and *B. simmondsi*, Mlk., are synonymous with *B. longissima*, Gestro, distinguishing them by colour characters and stating that all three occur on coconut in the Mandated Territory, as well as *Oxycephala papuana*, Gestro. The information on the bionomics, natural enemies and biological control of the two main species has already been noticed [29 377, 379]. Other methods of controlling *P. papuana* include the hand collection of eggs and adults and crushing the larvae in their mines at the beginning of an infestation on small trees, and passing flares, made by fastening half a coconut husk impregnated with kerosene or waste oil on the end of a bamboo pole, over the under surface of fronds of larger palms to kill the adults. In tests with dusts against the adults, lead arsenate gave the highest mortality whereas derris and pyrethrum gave very poor results. Of the sprays tested, one of lead arsenate and nicotine sulphate was the most satisfactory, giving a quick kill and a good residual effect. Since the common practice of removing and burning all fronds on which eggs or larvae of *Promecotheca* are seen may destroy large numbers of parasites, leaflets showing the presence of larvae should be hung in wire-gauze containers that will permit the escape of parasites but not of the beetles. The adults and larvae of *Brontispa*, which is chiefly of importance on young palms, can usually be easily killed by pouring nicotine sulphate down the central shoot, though in some particularly susceptible plants it is necessary to force lead arsenate in with a spray pump.

OTANES (F. Q.). **Locust Outbreak probable between 1941 and 1944.**—*Naric* 1 no. 4 pp. 281–286, 5 figs. Manila, 1941.

In 1940 and 1941, small sporadic swarms of *Locusta migratoria manilensis*, Meyen, ph. *transiens* occurred in several provinces of the Philippine Islands. Their appearance after a clear interval of two

years suggests that a new outbreak should be expected at any time between 1941 and 1944. The Bureau of Plant Industry has intensified scouting and control measures, particularly in Cotabato, which is known to be the chief outbreak area [*cf.* *R.A.E.*, A **30** 18].

WATANABE (C.). **Descriptions of three new Species of *Aphidius* parasitic on some Aphids of coniferous Trees.** (*Taxonomic Notes on Aphidiidae of Japan, III.*)—*Insecta matsum.* **15** no. 3 pp. 106–111, 2 figs., 7 refs. Sapporo, 1941.

The new species are *Aphidius jezoensis* bred from *Cinara nopporoensis*, Inouye, and *Lachniella costata*, Zett., both on *Picea jezoensis* and *P. glehnii*, and *A. inouyei* from *Cinara todocola*, Inouye, and *A. konoii* from *C. longipennis*, Mats., both on *Abies sachalinensis*. Descriptions are given of the adults of both sexes of the first two and of the male of the third, of which the female is unknown, and also of details in which females of *Coelonotus (Aphidius) pini*, Hal., bred from *Cinara pinea*, Mordv. (*pineti*, Koch) on *Pinus densiflora* differ from those previously reared from *C. laricicola*, Mats. [*cf.* *R.A.E.*, A **29** 445]. All these parasites were collected in Hokkaido.

JACK (R. W.). **Report of the Division of Entomology [Southern Rhodesia] for the Year ending 31st December, 1940.**—15 pp. multigraph. [Salisbury, S. Rhod.] 1941.

This report on insect pests in Southern Rhodesia is on the same lines as that for the previous year [*cf.* *R.A.E.*, A **30** 47]. There was little change in the position with regard to locusts, *Nomadacris septemfasciata*, Serv., being the only species of which swarms were recorded; there was practically no deposition of eggs or appearance of hoppers at altitudes greater than 4,000 ft. Pests of the main crops, in addition to those that attacked cotton [*cf.* **30** 83] and some recorded from the previous report [**30** 48], included *Agrotis (Euxoa) segetum*, Schiff., which caused serious loss of newly transplanted tobacco, and also of young maize, especially where it followed potatoes or late-ploughed heavy weed growth; *Brachytrypes membranaceus*, Dru., on tobacco; *Laphygma exempta*, Wlk., on maize and oats; *Eulepida mashona*, Agr., on oats; *Exora apicipenne*, Jac., *Heliothis armigera*, Hb., and *Cosmolyce (Cupido) boetica*, L., on sunn hemp (*Crotalaria juncea*); *Agromyza (Melanagromyza) phaseoli*, Coq., on beans (*Phaseolus*); *Ferrisiana (Ferrisia) virgata*, Ckll., on a variety of lima beans (*P. lunatus*); *Vanessa (Pyrameis) cardui*, L., *Achaea sordida*, Wlk., *Plusia (Phytometra) orichalcea*, F., and *Lamprosema indicata*, F., on soy beans; and *Alcidodes (Alcides) leucogrammus*, Erichson, on cowpeas.

Aonidiella aurantii, Mask., the only important insect pest of *Citrus* during 1940, was satisfactorily controlled by fumigation with Cyanogas calcium cyanide. Apples were infested by *Ceratitis (Pterandrus) rosa*, Karsch, during April and peaches by *C. capitata*, Wied., in October and November. Granadilla [*Passiflora*] was severely injured by *Pseudococcus* sp. during November. *Anoplocnemis curvipes*, F., caused the wilting of new growth of grape vines in September at Salisbury, and *Aulacaspis cinnamomi*, Newst., is increasing on mango there and in Umtali.

The Biology and Behaviour of *Ptinus tectus* Boie. (Coleoptera, Ptinidae), a Pest of Stored Products.

GUNN (D. L.) & HOPF (H. S.) **II. The Amount of locomotory Activity in Relation to experimental and to previous Temperatures.**—*J. exp. Biol.* **18** no. 3 pp. 278-289, 6 graphs, 20 refs. London, 1942.

EWER (D. W.) & EWER (R. F.) **III. The Effect of Temperature and Humidity on Oviposition, Feeding and Duration of Life Cycle.**—*T.c.* pp. 290-305, 4 figs., 22 refs.

The experiments described in the first of these papers, which belong to a series [*cf. R.A.E.*, A **29** 527], show that the amount of locomotory activity in adults of *Ptinus tectus*, Boield., is not a simple function of temperature, but depends on the temperature at which they have previously been kept, on whether the temperature to which they are being exposed is constant or changing, and, with changing temperatures, on the speed and direction of the change.

The following is substantially the authors' summary of the second paper. At 70 per cent. relative humidity, the duration of development of *Ptinus tectus*, Boield., from oviposition to adult emergence is shortest, averaging about 62 days, at 23-25°C. [73.4-77°F.]; at 15°C. [59°F.], the time taken is about 130 days. The minimum temperature at which complete development is possible is below 10°C. [50°F.] and the maximum is between 28 and 30°C. [82.4 and 86°F.]; at 28°C., mortality among eggs and larvae is considerable, and the eggs require 100 per cent. relative humidity for hatching. At lower temperatures, a relative humidity of 70 per cent. appears to be satisfactory for all developmental stages, but in air drier than this (at 25°C.) both eggs and larvae show increased mortality and prolonged development. The hatching of the egg, rather than embryonic development, seems to be affected by low humidity. Adults given food but not water live longer at 70 and 90 per cent. relative humidity (at 27 and 15°C. [80.6 and 59°F.], respectively) than at lower humidities. At 25°C. feeding is much reduced below 70 per cent. relative humidity if water is not given; at 34 per cent. there is little feeding even when free water is available. Larval feeding is also reduced at low humidities. Oviposition soon ceases unless drinking water is available, at any rate at low humidities. *Ptinus tectus* is thus adapted to a temperate climate with a high humidity.

CLINCH (P. E. M.). **Virus Diseases of Tomato.**—*J. Dep. Agric. Éire* **38** no. 1 pp. 24-47, 7 pls., 30 refs. Dublin, 1941.

The production of tomatoes in glasshouses has been developed on a commercial scale in Éire during the last six years, and this has aroused interest in the virus diseases that attack them. An account is therefore given of the characters, symptoms in tomato and other plants and modes of transmission of six of these diseases and the frequency in Éire of the five that have been observed there. The only one that is insect-borne is spotted wilt, which is caused by *Lycopersicum* virus 3 [*Lethum australiense* var. *typicum* of Holmes] and is spread chiefly by *Thrips tabaci*, Lind., but is also transmitted through the sap. It attacks plants of 19 different families; a list of those most commonly grown

as ornamental plants in greenhouses and of susceptible weeds is given. The disease has been reported in Eire almost every year since 1933, and in each case investigated by the author, chrysanthemums, arum lilies or dahlias had been grown in the same house, or near the tomato plants, the infection in arum lilies being very conspicuous. It is thought probable that the virus is introduced into new districts mainly in chrysanthemum cuttings, considerable numbers of which have been imported from England during recent years.

The disease is readily controlled except in mixed houses, where sources of infection amongst ornamental plants are sometimes difficult to detect. The crop should be examined for infection, and diseased plants should be removed immediately and burnt; the hands should be washed to remove any traces of infective juice after touching infected plants. Regular fumigation with nicotine should be carried out against the thrips, and possible alternate hosts, such as chrysanthemums, should be removed as far as possible from the tomato house.

LOUGHNANE (J. B.). **The Susceptibility to Leaf Roll of certain Potato Varieties and its Effect on their Yield.**—*J. Dep. Agric. Éire* **38** no. 1 pp. 48–67, 3 pls., 7 refs. Dublin, 1941.

An account is given of investigations in Ireland on the susceptibility to leaf-roll (*Corium solani* of Holmes) of 21 varieties of potato, including some recently introduced, and its effect on their vigour and yield. The experimental plots were in a field adjoining a market garden in which winter cabbages were grown [*cf.* *R.A.E.*, A **29** 329]. Counts of the Aphid populations on the plots during the growing seasons of 1937 and 1938 showed that *Myzus persicae*, Sulz., was the only efficient vector present. As conditions were very suitable for migration of *M. persicae* during April and May 1938, the initial infestation in potato was earlier and heavier than in 1937; similarly, the disease occurred earlier and the incidence was heavier. The first alate forms on cabbage were observed early in May in both years, but there were only two per 100 leaves on potato on 13th May in 1937, whereas 16 alate and 9 apterous forms per 100 leaflets were present on 12th May in 1938, and the apterae had nearly reached the adult stage. Compound leaves had not developed at this time. Maximum infestation by both forms occurred in mid-June in 1937 (162 per 100 leaves) and about 26th May in 1938 (63 alate and 155 apterous forms per 100 leaves), after which the populations decreased rapidly. In 1937, no primary leaf-roll was observed during June; it was found in all varieties by the middle of July and reached its maximum in the second half of July. In 1938, primary leaf-roll was observed on 9th June, but fewer infections developed between then and 11th July than between 11th and 27th July. These results accord with an earlier statement that the period between infection by *M. persicae* and the occurrence of visible symptoms is 30–40 days in young plants, 40–60 in older ones and the whole winter in full-grown plants. Since it was shown that plants in the drills next to a source of infection are more likely to become infected than those growing one or two drills away [*cf.* also **26** 47], it is concluded that in any single crop the main vectors of leaf-roll are the apterous Aphids, since infection by alatae would probably be scattered indiscriminately throughout the crop. The development of secondary leaf-roll in 1938 and 1939 in the varieties tested is discussed.

NOLTE (H. W.). **Freilandversuche mit den Delicia-Stäubemitteln Forststäubol II and III gegen Nonnenraupen.** [Forest Tests with two Delicia Dust Insecticides, Forststäubol II and III, against Nun Moth Larvae.]—*Tharandt. forstl. Jb.* **92** pt. 1-3 pp. 109-117, 1 fig., 6 refs. Berlin, 1941.

An outbreak of *Lymantria monacha*, L., was in progress in Saxony in 1939, and tests were carried out in May and June in forest stands of pine with an undergrowth of spruce on the value against the larvae of two proprietary dusts, one containing arsenic and the other dinitro-ortho-cresol. The principal method of estimating the results was to compare the numbers of eggs on the trunks of treated and untreated trees in the winter of 1939-40, and, judged by this standard, the two dusts gave 76 and 99.7 per cent. control, respectively. The one containing dinitro-o-cresol caused some scorching of the foliage on spruce but not on pine.

SCHAEFFENBERG (B.). **Die Nahrung des Maulwurfs (*Talpa europaea* L.).** [The Food of the Mole.]—*Z. angew. Ent.* **27** pt. 1 pp. 1-70, 10 figs., 6 pp. refs. Berlin, 1940. [Recd. 1942.]

A detailed account is given of investigations on the feeding habits of moles (*Talpa europaea*) in which field and laboratory observations were supplemented by the examination of the stomach contents of over 300 examples taken mostly in the Rhineland. They showed that the animals fed rather indiscriminately on the soil fauna and that in general their food consisted in about equal parts of earthworms and insects, chiefly harmful Coleopterous and Dipterous larvae, though the actual proportions varied with locality and season. In poor shallow soils, insects, especially Melolonthid and Elaterid larvae, formed the chief food, and in districts heavily infested by Melolonthids, larvae, pupae and adults were destroyed.

NIETZKE (G.). **Die Parasiten der Zwiebelminierfliege (*Dizygomyza cepae* Her.).** [The Parasites of the Onion Miner Fly.]—*Z. angew. Ent.* **27** pt. 1 pp. 71-83, 12 figs., 5 refs. Berlin, 1940. [Recd. 1942.]

The author describes the adults of both sexes and the distribution of the Miscogasterid, *Halticoptera patellana*, Dalm., and the Cynipid, *Microstilba bidentata*, Först., which were bred from puparia of *Agromyza* (*Dizygomyza*) *cepae*, Her., on onion in the Rhine Palatinate in 1937-38, the cyclopoid larva and the process of oviposition of the Cynipid and pairing in the Miscogasterid. The latter was much the more numerous and was reared from 35-40 per cent. of the puparia in one locality in 1937 and from 54 per cent. in another in 1938. Observations in 1938 showed that the adult populations of *A. cepae* and *H. patellana* both reached their peak on 8th June, but that of *M. bidentata* not until 1st July. The females of both parasites greatly outnumbered the males and oviposited in the host larvae in their mines. The greater part of the development of *H. patellana* took place in the puparium of the host, and some larvae diapaused. Puparia collected in August 1938 were found in October 1939 to contain pupating larvae of this parasite.

SCHIMITSCHEK (E.). **Beiträge zur Forstentomologie der Türkei III. Die Massenvermehrung des *Ips sexdentatus* Börner im Gebiete der orientalischen Fichte. II. Teil.** [Contributions to the Forest Entomology of Turkey. III. Outbreaks of *I. sexdentatus* in the Region of the Oriental Spruce. Second Part.]—*Z. angew. Ent.* **27** pt. 1 pp. 84–113, 8 figs., 14 refs. Berlin, 1940. [Recd. 1942.]

Forests of oriental spruce (*Picea orientalis*) in the region of Trebizond, on the Turkish Black Sea coast, have been severely attacked in the last 10 years by *Ips sexdentatus*, Börn. This Scolytid has two generations and a partial third in average years and normally attacks only unhealthy trees, fresh stumps and unbarked logs lying in the forest, but if it is unchecked, it multiplies rapidly and infests healthy trees, which it kills. It has many natural enemies, but they are never sufficiently numerous to control an outbreak unaided. Infestation of living trees can be recognised by the frass that is expelled while the breeding galleries are being formed, the exudation of resin, and finally the discoloration of the crowns, but control measures should be applied before this last stage is reached, since by that time the young adults are ready to emerge. Control measures include the felling of trap logs 2–3 weeks before each flight period. All infested trees should be felled, and the bark should be completely removed and burned. Infestation can be prevented to a great extent by preserving mixed forests in which spruce predominates. The measures required to prevent indiscriminate felling are discussed.

The parasites bred from *I. sexdentatus* comprised the Chalcidoids, *Cheilopachys colon*, L., *Entedon pinetorum*, Ratz., *Rhopalicus suspensus*, Ratz., and *Pteromalus lanceolatus*, Ratz., and the Braconids, *Coeloides abdominalis*, Zett., *Dendrosoter middendorffi*, Ratz., *D. middendorffi* var. *schimitscheki*, n., *D. protuberans*, Nees, and *Calyptus atricornis*, Ratz., var. *glabrata*, n. Descriptions of the two new varieties are given by Fahringer. The predators observed were *Raphidia* sp., *Placusa* sp., *Platysoma oblongum*, F., *Metoponcus brevicornis*, Erichson, *Nemosoma elongatum*, L., *Thanasimus (Clerus) formicarius*, L., *Hypophloeus fraxini*, Kug., *H. linearis*, F., and the Anthomyiid, *Helina deleta*, Stein. Notes are given on the bionomics, alternate hosts and relative frequency of these natural enemies. The Chalcidoids were commoner than the Braconids, but did not parasitise more than about 5 per cent. of the larvae. *Crypturgus apfelbecki*, Egg., and *C. cylindricollis*, Egg., develop in the cambium region of *P. orientalis* and use the galleries of *I. sexdentatus* and other bark-beetles as the starting point for their own breeding galleries.

Infestation by *I. sexdentatus* was accompanied or followed by attack by *I. spinidens*, Rtr., var. *heterodon*, Wachtl, *Rhagium (Harpium) inquisitor*, L., *Monochamus saltuarius*, Gebl., *Pogonochaerus* sp., *Pissodes* sp., *Pityophthorus pityographus*, Ratz., *Trypodendron (Xyloterus)* sp., and *Sirex (Paururus) juvenicus*, L. *I. spinidens*, which is the most important of these, has two generations and a partial third in the year, and it infested some trees, independently of *I. sexdentatus*.

TRÄGÅRDH (I.). **Neue Beobachtungen über den Schusterbock (*Monochamus sutor* L.) in Schweden.** [New Observations on *M. sutor* in Sweden.]—*Z. angew. Ent.* **27** pt. 1 pp. 142–149. Berlin, 1940. [Recd. 1942.]

An account is given of observations on *Monochamus sutor*, L., in northern Sweden in 1939 in the course of investigations on the

possibility of preventing this Lamiid from infesting the timber of conifers blown down in May by a storm that felled about 750 thousand trees. An examination of the fallen trees on 6th–8th June showed that *Myelophilus piniperda*, L., was completely absent from them, either because it had completed oviposition before the storm, or because the trees had not been completely uprooted. Since it has only one generation a year, there was no risk of increased infestation through the storm damage. *Ips sexdentatus*, Börn., occurred in the lowest 12 ft. of the trunks where the bark was thickest, often with *I. (Orthotomicus) proximus*, Eichh., higher up and *I. acuminatus*, Gylh., under the thin bark of the trunk and crown. Further south, adults of *Monochamus sutor* do not appear before July, and as the first part of the summer was exceptionally cold in 1939, this species was still in the pupal stage when the examination was made. Eggs and larvae of *Acanthocinus aedilis*, L., which is an early species, were also present. While the general situation was therefore favourable, an increase of *M. sutor* during the summer was to be expected, and it was recommended that the fallen trees should be barked in mid-September, which prevents the development of the young larvae by depriving them of the bast and outer layer of sapwood and limits their mines to the surface layers, which are removed when the wood is worked [cf. R.A.E., A 22 268]. Removal of the bark at an earlier date would expose the timber to the danger of cracking and blue rot. The upper third of each crown was sawn off to prevent loss of moisture by transpiration through the needles. Of 161 trunks examined on 24th–27th August, 61 per cent. had green crowns, 5·9 per cent. had half dry crowns, and 33·1 per cent. had crowns either completely or almost completely dry. Of the first group, only 5·8 per cent. were infested, and that solely by *M. sutor* or by *M. sutor* and *I. sexdentatus*, so that attack by these beetles was not connected with that by others. The wholly dry trees were infested by all the species referred to above. In 84·3 per cent. of the trees infested by *M. sutor*, eggs or newly hatched larvae were found, but no mines in the wood. Mines were found in the remaining 15·7 per cent of the trees, but few were more than an inch deep. The measures taken had therefore proved satisfactory.

In 1939, injury by *M. sutor* to raftwood was reported from saw-mills in northern Sweden. Very large quantities of logs are kept floating at the mills, sometimes for over a year, before they are barked, and the beetles had been seen flying in numbers in the summers of 1938 and 1939 above the floating timber. At a mill visited in August 1939, logs felled in the winter of 1938–39 showed infestation by *M. sutor*, the largest larvae being at depths of over two inches and the smallest at a depth of less than an inch. It was evident that the beetles had flown for some hundreds of yards over the water, and that the larvae had developed more quickly in the floating logs than they do in the forest, doubtless owing to the high temperature in such an exposed position. In logs that had been felled in the winter of 1937–38 and had been in the water during the following summer, infestation was only occasional and the larvae were not more than an inch long. It is considered that these logs had not been attacked until the summer of 1939, although oviposition in trunks felled two years before had not previously been observed. In view of these conclusions, floating timber must be regarded as a potential source of infestation.

BLANCHARD (E. E.). **Nuevos parasitos del bicho de cesto *Oeceticus kirbyi*, Guild.** [New Parasites of the Bagworm, *O. kirbyi*.]—*Rev. Soc. ent. argent.* **11** no. 1 pp. 3-21, 8 figs. Buenos Aires, 1941.

Of the new species described, all from Argentina, the Ichneumonids, *Balcarcia brethesi*, *Cryptopteryx oeceticola*, *Cryptus borsani*, *Ichneumonoglypta* (gen. n.) *lopez-richinii*, *Pimpla (Itoplectis) psychidophagus*, and *Paniscus oeceticola*, and the Chalcid, *Spilochalcis magistretti*, were reared from *Oeceticus kirbyi*, Guild., the Chloropid, *Gaurax oecetiphagus* is stated to destroy the eggs of this Psychid, and *Pimpla (Itoplectis) koehleri* was bred from *Clania deguerrei*, Köhler.

DE SANTIS (L.). **Las principales hormigas dañinas de la provincia de Buenos Aires.** [The chief injurious Ants in the Province of Buenos Aires.]—*Bol. Agric. Prov. B. Aires* **21** no. 1-3 repr. 40 pp., 11 figs., 295 refs. La Plata, 1941.

The first part of this bulletin comprises an account based on the literature of the distribution, habits and control of *Iridomyrmex humilis*, Mayr, which is generally known as the Argentine ant, though it is probably a native of the hotter parts of South America. In the Province of Buenos Aires it attacks foodstuffs in houses and fosters Aphids, Coccids and Aleurodids on fruit trees. It sometimes destroys other insects, both harmful and beneficial, including the brood in bee-hives, and also acts as a scavenger. It can be controlled by means of a sweetened bait containing sodium arsenite, similar to one already noticed [*R.A.E.*, A **23** 171]. The second part is a review of the habits and control of six species of *Acromyrmex* (leaf-cutting ants), of which the most harmful in the Province is *A. lundii*, Guér. Control measures include destruction or fumigation of the nests, dusting the entrances of the nests with arsenicals, and the use of poison baits.

HAYWARD (K. J.). **Departamento de Entomología.** [Department of Entomology (report for 1940 of the Tucumán Experiment Station).]—*Rev. industr. agric. Tucumán* **31** no. 1-3 pp. 50-58. Tucumán, 1941.

Coccids were numerous on *Citrus* in the province of Tucumán, Argentina, in 1940, their increase having been favoured by two mild winters. They included *Lepidosaphes beekii*, Newm., which killed some trees, *Lecanium deltae*, Lizer, which spread considerably, though it was partly controlled in one locality by a Coccinellid of the genus *Azya*, *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.), *Prontaspis (Unaspis) citri*, Comst., and *Pinnaspis aspidistrae*, Sign. One serious infestation by *Parlatoria pergandei*, Comst., was observed, and the Aleurodid, *Aleurothrixus howardi*, Quaint., and fruit-flies were common. Oranges suffered particularly from attack by the mite, *Phyllocoptiruta oleivorus*, Ashm.

Other pests included *Diatraea saccharalis*, F., and *Mocis repanda*, F., on sugar-cane, wireworms of the genus *Aeolus* on rice, *Toxoptera graminum*, Rond., on oats and barley [cf. *R.A.E.*, A **29** 36], *Tolyte guentheri*, Berg, on willow, *Promecosoma* sp. on *Eucalyptus*, *Cydia molesta*, Busck, on peach, *Eriosoma lanigerum*, Hsm., on apple, *Platycoelia inflata*, Ohaus, on apple, damson and *Citrus*, *Thyreion gelotopoeon*, Dyar, which attacked the seeds of sunflowers, *Phyrdenus muriceus*, Germ., on tomato, *Ascia (Pieris) monuste automate*, Burm., on

crucifers, *Agrotis ypsilon*, Hfn., on potato, cotton seedlings and beet, *Laphygma frugiperda*, S. & A., and *Hymenia (Zinckenia) perspectalis*, Hb., on beet, *Mettriona sexpunctata*, F., *Chelymormpha guttula*, Boh., *Zatrephina imperialis*, Guér., and *Poecilapsis angulata*, Germ., on melon and potato, *Atteva punctella*, Stoll, *Chioides catillus*, Cram., and *Anticarsia irrorata*, F., on soy bean, and *Faustinus (Euxenus) variegatus*, Hust., and *Heliothis virescens distincta*, Schaus, on tobacco. The Chalcid, *Brachymeria ovata*, Say, which parasitises *Alabama argillacea*, Hb., on cotton, was bred from *Mocis repanda*. The distribution of parasites was continued, including Tachinids against *A. argillacea* and many parasites of fruit-flies.

[WATERSTON (J. M.).] **Plant Pathology.**—*Rep. Dep. Agric. Bermuda 1940* pp. 6-8. [Hamilton] Bermuda, 1941.

Attack by *Gnorimoschema (Phthorimaea) operculella*, Zell., was again severe on potato tubers in storage, and in some cases even in the field in Bermuda in 1940 [cf. R.A.E., A 29 138], and all potatoes for export after a certain date, as well as many for local use, were fumigated with methyl bromide, which gave complete control without injury to the tubers when used at the rate of 2 lb. per cu. ft. space [sic? per 1,000 cu. ft.] for two hours in a fumigation chamber or under tarpaulins. Special precautions against the introduction of *Popillia japonica*, Newm., were continued [cf. 28 496]; one adult was caught in a garden on 1st June, but the only others found were two on a steamship from New York, eight weeks later. One adult of *Leptinotarsa decemlineata*, Say, was taken on potatoes imported from Canada. The Lamiid, *Leptostylus praemorsus*, F., which is a pest of ornamental trees and Bermuda cedar [*Juniperus bermudiana*], severely injured *Citrus* by tunnelling beneath the bark.

FENNAH (R. G.). **Citrus Pests Investigation. Report on a Visit to Jamaica in November, 1940.**—*J. Jamaica agric. Soc.* 45 no. 4 pp. 115-118, 120-123, 1 fig. Kingston, 1941.

This survey was carried out to determine the extent to which weevils of the genus *Prepodes* are responsible for damage to *Citrus* in Jamaica, and the measures most suitable for use against them.

Of 50 dead or unhealthy trees examined in November 1940, feeding tracks of larvae, including species of *Prepodes*, *Pachnaeus* and *Lachnosterna*, were present on the roots of 43, and larvae of *Prepodes* were more numerous than those of the other two genera combined. The injury was caused solely or principally by the larvae in 14 trees and partly by other causes in 15. The larvae remove strips of bark from the roots, generally from the underside, often girdle large roots within 2 ft. of the trunk, and scar the tap root and any large vertical roots near it. The main roots of trees that have been seriously damaged or destroyed by the larvae are girdled near the base, and most of the bark is removed from below the crown; slow-growing trees lacking vigour are sometimes destroyed when the roots are girdled farther than 2 ft. from the trunk, owing to the inability to produce new rootlets at the points of girdling. The symptoms accompanying infestation are those characteristic of extensive root injury and comprise yellowing or falling of the leaves, dying back of twigs, the setting of a heavy crop of fruit, and, in severe cases, dropping of the fruit.

Prepodes spp. are unlikely to be controlled by natural enemies, as they are indigenous to Jamaica and in equilibrium with native parasites and predators. The most important parasites are Eulophids of the genus *Tetrastichus* [cf. R.A.E., A 27 239; 28 495], but in November, only 11.7 per cent. of the egg-masses in two districts were parasitised by them, and only 2 per cent. of the eggs were destroyed. Two unidentified species of fungi were observed infesting the adults, and it is thought that one occasionally destroys the larvae. Egg-parasites of weevils of the allied genus *Diaprepes* [cf. 26 403, etc.] might be of some value against *Prepodes* if introduced into Jamaica.

The most effective artificial control measure is to remove the soil from the main roots between the trunk and the point at which they fork, to prevent the larvae from reaching and girdling them [cf. 26 403]. This treatment is facilitated by planting young trees on mounds; the mounds subside more quickly than the trees, and in two years or less the main roots are exposed where they join the trunk. In established groves, the soil should be removed from the roots by hand, after being dislodged with a stick, to avoid scraping the bark. The excavations must be kept open and free from weeds. The method is impracticable if the trees have developed vertical instead of horizontal roots, as they do on heavy soils in Jamaica; in such cases attempts should be made to destroy the larvae by sprinkling powdered lead arsenate on the soil below the canopy of the tree, at the rate of 1 lb. per 100 sq. ft. of soil surface, in late March or early April, when the larvae are entering the soil. It is probable that the first-instar larvae ingest a small amount of soil when burrowing downwards, as those of *Diaprepes* are known to do.

Young *Citrus* trees are sometimes defoliated by the adults of *Prepodes*, which chiefly attack the new growth, and, in grass-covered orchards, also by Tettigoniids and slugs. The Tettigoniids can be to some extent repelled by a lead-arsenate spray containing an adhesive, and leaves so sprayed would be toxic to adults of *Prepodes* that ingested them, but adults of allied species usually traverse the leaves without feeding on them.

Factors other than insect infestation that affect the growth of *Citrus* and produce symptoms resembling those due to root damage by *Prepodes* larvae are discussed in some detail.

CALLAN (E. McC.). **The Gall Midges (Diptera, Cecidomyiidae) of economic Importance in the West Indies.**—*Trop. Agriculture* 18 no. 6 pp. 117–127, 1 map, 15 refs. Trinidad, 1941.

In this paper the author deals at greater length with the bionomics of the eight Cecidomyiids that are pests of crops in the West Indies [cf. R.A.E., A 28 633], and reviews the literature on them.

Observations on *Contarinia sorghicola*, Coq., in Trinidad, where its bionomics are similar to those recorded in the United States [cf. 17 86] showed that the life-cycle lasts about 12 days, so that several generations are produced during the 2–3 months in the dry season when cultivated sorghum may normally be in seed. During the rest of the year, the population is maintained on self-sown sorghum and wild grasses. Prior to adult emergence, the pupa penetrates the seed coat and projects from the seed, and the empty pupal cases remaining after the escape of the adults are evidence of infestation. Males emerge earlier and are less numerous than females. Mating and oviposition follow soon

after emergence, and the adult life does not exceed 2 days. Despite the activities of seed-eating birds, fluctuations in the yield of sorghum from year to year are due largely to infestation by *C. sorghicola*, which causes an average loss of about 25 per cent., and in some years more than 50 per cent., of the crop of Guinea corn. The loss is rather less in the case of broom corn. Parasites recorded from *C. sorghicola* in the United States include the Eulophids, *Aprostocetus diplosidis*, Crwf., and *Tetrastichus* sp., which attack the larvae, and *Eupelmus popa*, Gir., which attacks the larvae and pupae and has also been recorded in Curaçao. In Trinidad, the author has bred *A. diplosidis* in considerable numbers from the Cecidomyiid, while associated with this parasite were *Ceratoneura petiolata*, Ashm., *Tetrastichus* sp. and a species of *Eupelmus* near *E. urozonus*, Dalm.

Cultural methods of control are the most important against *C. sorghicola*; in Trinidad, the crop should be planted as early as possible in October and harvested early in January or February. Its flowering should be kept uniform, and self-sown and early flowering plants should be suppressed. A close season should be established from March to September, when all growing sorghum should be destroyed or at least prevented from flowering; Johnson grass (*Sorghum halepense*) and other wild food-plants should be eliminated.

Surveys in 1939 and 1940 showed that *Contarinia lycopersici*, Felt, occurs on tomato not only in Trinidad, Barbados, St. Vincent and Grenada [cf. 28 633], but also in St. Lucia, Dominica, British Guiana and British Honduras. No alternate food-plants of this Cecidomyiid are known. Of 572 tomato flowers received from Trinidad, Grenada, St. Lucia, Dominica, British Guiana and British Honduras in 1938-40, 107 were infested by it. The average numbers of larvae per infested flower in any one sample ranged from 2.5 to 16, with a mean of about 7, but single flowers contained up to 60. Flowers containing more than 12 larvae are usually completely destroyed. When fully grown, the larvae leave the flower bud, make their way to the ground and pupate in the soil at a depth of about $\frac{1}{2}$ inch. A high degree of moisture is essential for pupation. No breeding experiments were carried out, but a technique for rearing adults from larvae was developed and is described. Of the 46 examples reared, 36 had a pupal stage of 9-10 days and the remainder one of 11-12 days. The egg and larval stages probably last about 2 and 8-10 days. Individuals of a species of *Sactogaster* were bred from *C. lycopersici* in Trinidad, and examples of apparently the same Scelionid were found in 1939 and 1940 in tomato flowers from Grenada. It is concluded that in Trinidad, *C. lycopersici* is chiefly responsible for serious shedding of flowers that has been attributed to other causes. Infestation ranged up to 83 per cent. of the flowers, and the majority of those attacked are almost always severely damaged, if not completely destroyed. The most practical method of control is to restrict tomato cultivation to the dry season and keep the surface layers of the soil as dry as possible.

Parasites recorded from *Contarinia gossypii*, Felt, on cotton include the Pteromalid, *Catolaccus* sp., and the Scelionids, *Sactogaster rufipes*, Ashm., and *Leptacis* sp., in Antigua. Those recorded from *Iatrophobia brasiliensis*, Rübs., on cassava (*Manihot utilissima*) comprise *Tetrastichus fasciatus*, Ashm., in St. Vincent [cf. 6 121] and *Aprostocetus* sp. and *A. fidius*, Gir., in Trinidad [cf. 19 27], while the author himself obtained *T. fasciatus* in considerable numbers from this Cecidomyiid in Trinidad and British Guiana.

GABLE (C. H.), BAKER (W. A.), WOODRUFF (L. C.) & WALTER (E. V.).
The Sorghum Midge, with Suggestions for Control.—*Fmrs' Bull.*
U. S. Dep. Agric. no. 1566 (revd), 9 pp., 10 figs. Washington,
 D.C., 1941.

This bulletin on the bionomics and control of *Contarinia sorghicola*, Coq., in the United States, where it is the most serious insect pest of grain sorghum and also causes great losses in seed crops of sweet sorghums, broom corn and Sudan grass [*Sorghum sudanense*], is a slightly revised edition of one already noticed [*R.A.E.*, A 17 86]. In addition to all the sorghums, it infests purpletop (*Triodia flava*), but apparently does not breed extensively in any other native wild grass. Two of the three Hymenopterous parasites that were formally very abundant are stated to have almost disappeared. The third is *Eupelmus popa*, Gir. [17 376], which now occurs in all districts where *C. sorghicola* is abundant. Recommendations for the control of *C. sorghicola* include using only pure seed of as uniformly blooming a strain as it is possible to obtain and, where two varieties flowering at different times are sown near to each other, arranging them so that the prevailing wind blows towards the earlier variety; cutting Johnson grass [*Sorghum halepense*] or sorghum hay in neighbouring fields and removing it several days before the grain crop begins to flower, or, where this cannot be done, delaying mowing until flowering is completed to prevent the migration of adults from the cut grass to the grain sorghum; and cutting individual heads that bloom before the main crop and leaving them on the ground or, if they are cut later than 5 days after the first flowers appear, removing and destroying them.

DOUGLAS (W. A.). **Field Infestation by Insects that injure Rice in Storage.**—*Circ. U. S. Dep. Agric.* no. 602, 8 pp., 1 fig., 1 ref. Washington, D.C., 1941.

The following is based on the author's summary. Conditions in rice storage warehouses in the southern United States are such that the increase of insects attacking stored rice is favoured and effective fumigation for their control is rendered almost impossible. The importance of storing uninfested rice in an uninfested warehouse is thus apparent. The difficulty of controlling the insects after the grain is stored led to a study, carried out in Louisiana during 1934-37, of possible sources of field infestation and methods of reducing the numbers of insects already present in rough rice when it is put into storage. At least 25 species of insects attack stored rice or rice products, and 8 cause serious losses; in order of importance, these are *Sitotroga cerealella*, Ol., *Calandra* (*Sitophilus*) *oryzae*, L., *Rhizopertha dominica*, F., and *Tenebroides mauritanicus*, L., in rough rice, and *Oryzaephilus surinamensis*, L., *T. mauritanicus*, *Tribolium castaneum*, Hbst., *C. oryzae*, *Corcyra cephalonica*, Staint., and *Plodia interpunctella*, Hb., in cleaned rice.

This study established that the chief sources of field infestation of rice by insects attacking it in storage are, in order of decreasing importance, storage warehouses, straw-stacks, and fields of maize or sorghum. Counts of representative samples indicated that there may be as many as 100,000 rice insects per ton of straw in the rice straw-stacks. No variety of rice is significantly resistant to insects that attack stored rice. The insect populations usually found in stored rice do not seriously affect the germination of the seed.

Recommendations for reducing the number of insects taken into warehouses from the fields are to clean warehouses thoroughly and dispose of all old grain before the new crop of rice heads ; to dispose of straw-stacks by the end of May, when green pasture becomes available for the cattle that have been feeding on them, either by burning the straw or spreading it on stubble fields and ploughing it in ; and to avoid planting maize or sorghum near rice-fields.

Summary for 1940.—*Insect Pest Surv. Bull.* **20** no. 10 pp. 559–591, 3 maps, multigraph. Washington, D.C., U.S. Dep. Agric. Bur. Ent. [1941.]

The insects pests that occurred in the United States during 1940 are discussed as in previous years [*R.A.E.*, A **29** 47] ; the winter of 1939–40 had been unusually severe over most of the area east of the Great Plains, and many of the pests in the south-eastern States were consequently much less injurious than usual, though those that occur further north were protected by adequate snow cover. The spring and summer were cool in the east and warm west of the Rocky Mountains ; the autumn in most areas was very favourable for insect development.

Dissosteira longipennis, Thos., was no longer of economic importance in Colorado and New Mexico, owing to cool wet weather at hatching time, the activities of parasites and predators and intensive control measures. Adults of *Melanoplus mexicanus*, Sauss., that entered north central Montana in 1939 [29 428] laid large numbers of eggs there, but only minor losses were sustained in 1940 owing to the use of baits. Adults of the overwintered generation migrated from south-eastern Colorado, north-western Oklahoma and northern Texas, and spread over most of western Kansas ; summer-generation adults began to migrate from this State and from southern Nebraska in late September, and by mid-October infestation extended for 100 miles into Texas. Marginal wheat was completely destroyed over considerable areas in the southern part of the infested area, but as a result of control activities continued into early November, subsequent cold, parasitism and other natural causes, almost all these adults were killed. *Aeoloplus turnbulli*, Thos., caused severe marginal and field damage in Kansas in 1939 but weather conditions in 1940 were such that there was little migration from marginal to field wheat, and field damage was slight. *M. occidentalis*, Thos., which was present in only a small area in central Nevada in 1938, occurred over an area of 86,500 acres in the autumn of 1940. Damage to crops by this species has been insignificant, and destruction in range land only local. There was a marked reduction in the area infested by the Mormon cricket [*Anabrus simplex*, Hald.], and also in the areas of heavy infestation. Eggs deposited in two counties of Wyoming in 1939 did not hatch in 1940, but many showed considerable embryonic development by the autumn of that year.

The European corn borer [*Pyrausta nubilalis*, Hb.] occurred in 22 previously uninfested counties in Illinois, Maryland, Ohio, Virginia and Wisconsin. Some of the highest populations yet recorded in the United States were observed in a county on the mainland of Virginia, where the average number of larvae per 100 maize plants was 601.2, and some plants contained more than 100 larvae. The average infestations in two counties in New York were 742.2 and 709.6 larvae per

100 plants. An increased trend towards the production of a second generation was observed in some of the Lake States, notably in Indiana and in south-western Ohio. A new area of major infestation by the white-fringed beetles, *Pantomorus leucoloma*, Boh., and *P. peregrinus*, Buchanan, in which the latter species predominated, was observed in Mississippi, and *P. leucoloma* occurred in an isolated area 24 miles further south. In general, economic damage by these weevils was very slight. Inspections of lucerne and sour clover [*Melilotus indica*] indicated that the area in California and Arizona infested by *Hypera brunneipennis*, Boh. [29 628] had increased slightly in extent, and an additional small, light infestation was found in Arizona. After aestivating during the summer and autumn, the adults migrate to the lucerne and sour clover in the Yuma Valley between late November and mid-December; populations were smaller than in 1939. The first adults to emerge began to oviposit during the first week in December, and most of them were ovipositing by the latter part of the month, but cool, rainy weather during the second half of December reduced egg production and retarded hatching to such an extent that no larvae had appeared by 27th December.

In Louisiana, only about one-tenth the normal number of larvae of *Diatraea saccharalis*, F., survived the winter in sugar-cane and less than half in rice stubs, owing to the exceptionally cold weather. The percentage of joints bored was only 5.3 in 1940. *Parlatoria chinensis*, Marl., which has been recorded in China, Japan, Egypt and India, but not in the United States, was found on plants of 48 genera in two places in park areas of the city of St. Louis, Missouri. The oriental fruit moth [*Cydia molesta*, Busck] was reported as injurious in Texas for the first time during 1940, when it attacked peach and plum.

Populations of the beet leafhopper [*Eutettix tenellus*, Baker] in the breeding areas of southern Idaho, northern Utah and California in the autumn of 1939 were the lowest for several years, and winter survival was also low, but spring conditions in southern Idaho favoured the building up of large populations. Surveys in July showed that the percentage infection of beans with curly-top ranged from 0.25 to 44. The average percentage infection of beet in Idaho and eastern Oregon was 75.7 as compared with 37.7 in 1939. Great numbers of migrants from southern Idaho, southern Nevada and north-eastern Arizona reached northern Utah in April, and damage to sugar-beet and tomato there was five times as great as in 1939. In California, the first generation remained in the foot-hills, where a large second generation developed. In May, the heaviest migration recorded since studies were started in 1930 occurred, but the migrants missed the principal beet-growing areas in the Sacramento Valley, and damage to sugar-beet was, in general, negligible. In the southern part of the San Joaquin Valley, however, injury to early tomatoes amounted to at least 10 per cent., and in the canning tomato area of the northern part the percentage was about 30, reaching 60 in a few fields. As a result of favourable weather during autumn and winter in valleys in New Mexico and Arizona in which beet is grown for seed, breeding took place in the beet fields, which is unusual; curly-top injury was the most severe yet experienced, but where resistant seed was used, little damage occurred. During a survey between July 1937 and the beginning of 1940, the sweet potato weevil [*Cylas formicarius*, F.] was found in 39 counties in Alabama, Georgia, Mississippi and Texas; it had been eradicated from 11 counties by the end of 1940.

Damage to tobacco by *Protoparce* spp. in the dark fire-cured and Kentucky burley areas was exceptionally light; this was largely due to the cold winter, but the unusual abundance of *Apanteles* spp. in August and September was a contributing cause. Pupae of *Protoparce* in packed soil survived the severe cold in South Carolina when only 2 ins. below the surface; whereas others in loose soil were killed, probably owing to the freezing of water that accumulated in it, even when they were as deep as 7-8 ins. The population did not appear to be materially reduced by the cold in this area; the percentage survival of pupae in individual cells used for hibernation studies was 24.8. Infestation was slight in the Connecticut River Valley, where the predominant species is *P. quinquemaculata*, Haw., and there was little parasitism by *Apanteles congregatus*, Say, which is usually abundant. Relatively heavy oviposition by *P. sexta*, Joh., in Florida and Georgia between 25th May and 22nd June was due to females of both the overwintered and first generations. Incidence was about normal, and injury to sun-grown tobacco was locally severe. The vegetable weevil [*Listroderes obliquus*, Gylh.], which first attacked seedling tobacco in Florida in 1937 [26 144], has continued to infest the seed beds each season. In April 1940, the larvae were found feeding on small tobacco plants in plant beds in South Carolina; adults and larvae were later collected, and some of the latter completed their development. This is the first record of *L. obliquus* on flue-cured tobacco.

Examinations of the root-systems of 30 trees during 1939 and 1940 showed that the eastern hemlock borer, *Melanophila fulvogutata*, Harr., can successfully attack eastern hemlock [*Tsuga canadensis*] only when the trees are already dying from other causes. The abundance of this Buprestid showed a noticeable reduction for the first time since 1937, owing to favourable growing seasons in 1938 and 1939; the season of 1940 was also favourable, and the decrease is expected to continue. Losses of ponderosa pine [*Pinus ponderosa*] caused by *Dendroctonus brevicomis*, Lec., continued to occur in Idaho, Montana and California, increased in Washington State and reached epidemic proportions in parts of Oregon, where direct control measures were necessary. *D. pseudotsugae*, Hopk., again caused widespread destruction of Douglas firs [*Pseudotsuga taxifolia*] in the Rocky Mountains [29 49], but there were only two minor outbreaks in Oregon, where fire-scorched trees were attacked, and one in Washington. The outbreak of *D. ponderosae*, Hopk., on *Pinus ponderosa* in Colorado and southern Wyoming continued to decline [29 49] but in Utah infestation was considerably more aggressive, though treatment of approximately 17,000 infested pines in one area resulted in a reduction in infestation there of 92 per cent.; the outbreak of this Scolytid on lodgepole pine [*P. contorta*] in Utah reached epidemic proportions. There was a marked increase in loss from current infestations of Jeffrey pine [*P. jeffreyi*] by the Jeffrey pine beetle [*D. jeffreyi*, Hopk.] in north-eastern California. The outbreak of *Hemerocampa pseudotsugata*, McDunn., on *P. taxifolia* [29 49] decreased during 1940, and no visible defoliation occurred. The numbers of the European spruce sawfly [*Gilpinia polytoma*, Htg.] in southern Vermont and southern New Hampshire were very greatly reduced by a disease that attacked the larvae [29 422] and that was also observed in Maine [cf. 29 531] in September; infestation increased in a few districts, however. *G. frutetorum*, F., which was also introduced from Europe and is now established, but not injurious, in Connecticut, Massachusetts, New

Hampshire, New Jersey, New York, and a few localities in Ontario, Canada, increased in numbers in some parts of New England and New York during 1939 and 1940. The larvae feed on red pine and Scots pine [*Pinus resinosa* and *P. sylvestris*], and in New England there is one generation and at least a partial second in a year. *Neodiprion lecontei*, Fitch, which is a serious pest in pine plantations but is rarely destructive in natural stands, destroyed a 20-acre plantation of *P. resinosa* in northern New York, and caused serious defoliation in pine plantations in other counties in northern New York and in Vermont. An undescribed species of *Neodiprion* that has attacked plantations of *P. resinosa* in Vermont, New Hampshire and Massachusetts since 1935 defoliated trees in plantations in the last two States and in New York, and a natural stand in Massachusetts. Defoliation of larch by *Pristiphora* (*Nematus*) *erichsoni*, Htg., which appeared near the Canadian border in 1933 and has since spread southwards, was severe. The beech scale [*Cryptococcus fagi*, Bär.] is generally distributed throughout Westchester County in New York and has been found west of the Hudson River; infestation was very heavy in north-central Maine, where it was followed by infection by the fungus, *Nectria* [*coccinea* (cf. 22 497)]. *Phorocera* (*Parasetigena*) *silvestris*, R.-D., an important European parasite of the gipsy moth [*Lymantria dispar*, L.], has been liberated over a number of years in 22 places in New England, but was not recovered until 1940, when it was numerous in several localities in Massachusetts. Apple orchards and elms in some localities in New Hampshire were completely defoliated by larvae of the brown-tail moth [*Nygmia phaeorrhoea*, Don.].

Service and Regulatory Announcements, July-September 1941.—

S.R.A., B.E.P.Q. no. 148 pp. 65-84. Washington, D.C., U.S. Dep. Agric., 1941.

As a result of recent experiments, Administrative Instructions (B.E.P.Q. no. 499 supplement no. 1 fourth revision) relating to Quarantine no. 48 against the Japanese beetle [*Popillia japonica*, Newm.] authorise the fumigation with methyl bromide by a method already described [R.A.E., A 27 591] of plants with bare roots or in 14 in. pots or smaller or in soil balls not larger than 14 in. in diameter or thicker than 14 ins. when not spherical at dosages of $1\frac{1}{2}$ and 2 lb. per 1,000 cu. ft. for $2\frac{1}{2}$ hours at a temperature of the soil (or root spaces of bare stock) and air of at least 73 and 67°F., respectively, and of $2\frac{1}{2}$ lb. for $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4 and $4\frac{1}{2}$ hours at 63, 60, 57, 54 and 50°F., respectively.

Administrative Instructions (B.E.P.Q. 515 revised) relating to Quarantine no. 64 against the Mexican fruit-fly [*Anastrepha ludens*, Lw.] modify the method of sterilising oranges and grapefruit by cold treatment [20 572] in the regulated area of Texas by requiring sterilisation at or below 33, 34 or 35°F. at the centre of the fruit for 18, 20 or 22 days, respectively.

Announcements relating to Quarantine no. 72 against *Pantomorus leucoloma*, Boh., and *P. peregrinus*, Buchanan, include Administrative Instructions (B.E.P.Q. 503 third revision) for the treatment of plants in pots or soil balls and of potting soil by methods already described [27 591; 28 490, 610; 29 568]. The requirements for treating plants in soil balls with an aqueous solution of methyl bromide and ethyl alcohol against both species are slightly modified. The maximum

diameter of the soil balls, their temperature during treatment and the time they must remain embedded in the sand are 7 ins., 65°F. and eight hours in the regulated parts of four parishes in Louisiana [cf. **29** 568], and 8 ins., 62°F. and six hours elsewhere.

Other information in this part includes supplements to plant-quarantine import restrictions already noticed from Uruguay, Mexico, British Guiana, Bermuda and South Africa.

LANE (M. C.). **Wireworms and their Control on irrigated Lands.**—*Fmrs' Bull. U. S. Dep. Agric.* no. 1866, 21 pp., 18 figs. Washington, D.C., 1941.

The most important of the wireworms that have become injurious in the irrigated lands of the north-western United States are *Pheletes (Limonium) canus*, Lec., *P. (L.) californicus*, Mannh., *L. infuscatus*, Motsch., and *P. (L.) subauratus*, Lec. They are native to the region but, owing to the dry condition of unirrigated soil during the practically rainless summer over the greater part of it, were originally restricted to the naturally damp soils near streams and lakes. A brief account is given of their bionomics, the nature and extent of the injury they cause to crops, and the appearance of the various stages. The larvae pupate in July or August and the pupal stage lasts about three weeks, but the adults do not emerge from the soil until the following spring, after which they mate, oviposit, and die in 3–4 weeks. The eggs hatch within a month. The life-cycle lasts from two to six years, varying with conditions of soil, temperature and food, but is usually completed in three or four years in the lower and warmer districts. Most of the larvae are more than 6 ins. below the surface of the soil for the greater part of the year. They begin to migrate upwards when the soil temperature reaches about 50°F., generally at the end of March, and continue until June, when surface temperatures of 80°F. and more result in a downward movement. Only a few larvae migrate upwards again in September.

The methods of control that have been found of value are soil fumigation, if the crop justifies the expense, and cultural measures. Fumigation of the soil with carbon bisulphide is most effective during the period from June to September, when the temperature at a depth of 6 ins. exceeds 60°F.; injections of 1 fl. oz. to a depth of 2–3 ins. at points not more than 24 ins. apart in each direction should give over 90 per cent. mortality of all stages. The soil should be ploughed and smoothed before treatment and ploughed again about a week later; crops can be planted out with reasonable safety 10 days after the application. No further treatment is required for several years. Crude naphthalene, which is a little less effective, is best applied during May and June by distributing it along the sides of furrows 10–12 ins. deep at the rate of 19 oz. per 100 linear feet of 12 in. furrow slice (500 lb. per acre). The furrow slice should not be wider than 12 ins., and the naphthalene should be 90 per cent. pure. After the application, the field should be disked as deeply as possible.

Cultural methods include flooding the fields to a depth of 2–3 ins. for about a week in July or August, when the soil temperature at a depth of 6 ins. averages 70°F. or more [cf. *R.A.E.*, A **25** 174; **26** 569]; drying the soil to a depth of 18 ins. for several weeks in summer every five or six years by growing deep-rooted crops such as lucerne and autumn grain [cf. **23** 540] and withholding irrigation for the whole

season and in the previous autumn, which on well-drained sandy and clay loam soils affords mortalities of about 80 per cent. ; ploughing between 15th July and 15th August to destroy the pupae [25 248] ; and adopting a crop rotation to avoid growing red or sweet clover [*Trifolium* or *Melilotus*], which favours increased wireworm populations, in the same field in successive years, or in rotation with susceptible field or vegetable crops, especially potatoes. Infestation decreases when asparagus is grown for several successive seasons on the same soil, but increases under other field and vegetable crops. Growing lucerne with the minimum amount of irrigation until after the first cutting produces conditions very unfavourable for wireworms, and by adopting this procedure for four successive years, populations can be reduced in readiness for vegetable crops [cf. 27 378]. Pasture-sod conditions are also detrimental to wireworms. Such crops as sugar-beet, potatoes, onions, carrots and peas should be sown early enough to have passed the susceptible stage before the wireworms feed near the surface, whereas the sowing of maize, beans, melons, cabbage and tomatoes should be delayed until the larvae have migrated below the seed depth. As they move downwards in June and July, the larvae feed on roots and tubers at a depth of 3-6 ins., and early potatoes should therefore be harvested as soon as possible ; in districts with long growing seasons, damage to late potatoes can be reduced by delaying planting until as late as possible in June, so that the tubers are developing in August, when most larvae are at depths lower than 6 ins.

CHAPMAN (P. J.) & HESS (A. D.). **Mortality of the Apple Maggot in Fruit held in Cold Storage.**—*Circ. U. S. Dep. Agric.* no. 600, 9 pp., 4 figs., 5 refs. Washington, D.C., 1941.

The following is largely the authors' summary. Since many countries prohibit the importation of apples that contain any live eggs or larvae of *Rhagoletis pomonella*, Walsh, studies were made in 1936 to determine the effectiveness of cold storage for disinfesting fruit intended for export from the United States. Complete mortality of eggs and larvae in fruit placed in refrigeration rooms was effected within 32 and 45 days at air temperatures of 32 and 36°F., respectively. Larval progress through the fruit appeared to stop in storage at both temperatures, but continued slowly at 40°F., although all but a few individuals eventually died. Since the air movement in the storage chamber was limited to that induced by gravity, the temperature of the fruit in the interior of the package remained nearly 1°F. above the air temperature. In commercial cold storage at approximately 32°F., 40 days should provide ample time for equalisation of fruit and air temperatures, as well as for complete mortality, and allow a margin of safety.

SHROPSHIRE (L. H.). **Insect Control for Garden Crops.**—*Circ. Univ. Coll. Agric. Ill. Ext. Serv.* no. 514, 54 pp., 29 figs., 1 ref. Urbana, Ill., 1941.

In addition to notes on the appearance, life-history and control of some 50 species or groups of insects that injure vegetables in Illinois and the damage caused by them, this revision of a previous bulletin [R.A.E., A 24 115] includes a section dealing with general pests of

garden crops and two shorter ones on the feeding habits of insects and general control measures. The section dealing with insecticides and directions for the preparation of various sprays, dusts and baits is extended and brought up to date.

HOEGEMEYER (L. C.). **An Association of Root Injury by White Grubs, *Phyllophaga* spp., and Lodging of Crossbred Strains of Corn.**—*J. Amer. Soc. Agron.* **33** no. 12 pp. 1100–1107, 4 figs., 8 refs. Geneva, N.Y., 1941.

The following is substantially the author's summary. In a study in Kansas of the resistance to damage by the larvae of *Lachnosterna* (*Phyllophaga*) spp. in Kansas among the progeny of six inbred lines of maize and all possible single- and 29 of the possible double-cross combinations among them, differential root injury and lodging were detected. Combinations of certain inbred lines resulted in some single crosses and double crosses that were superior and in others that were inferior in the amount of root injury by the larvae and in subsequent lodging. Certain single crosses were less injured than the double crosses involving them as parents.

SNELLING (R. O.). **The Place and Methods of Breeding for Insect Resistance in cultivated Plants.**—*J. econ. Ent.* **34** no. 3 pp. 335–340, 23 refs. Menasha, Wis., 1941.

The author discusses the importance of insect resistance in economic plants and the organisation of programmes for breeding plants to develop resistance to insects, and gives an account of methods adopted. The four general procedures for the utilisation of resistance in plant improvements comprise introduction from other countries or localities, which often provide a source of greater resistance than may exist in local strains; selection of strains from varieties, introductions or hybrids to improve resistance while retaining desirable agronomic characteristics; hybridisation between resistant species or varieties and those not resistant but possessing other desirable characters; and grafting susceptible but otherwise desirable species or varieties upon resistant strains. Examples of each of these methods are given.

BIGGER (J. H.). **Breeding Corn for Resistance to Insect Attack.**—*J. econ. Ent.* **34** no. 3 pp. 341–347, 50 refs. Menasha, Wis., 1941.

The author gives an account, based mainly on the literature, of the development in the United States of methods of breeding varieties of maize resistant to attack by insects. It was discovered before 1917 that the plants show a differential response to insect attack, but there was little organised research. Later, organised attempts were made to locate strains or varieties of maize resistant to the attack of various insects, the studies being based on apparent morphological characters. In recent years, with the development of maize improvement by the use of inbred lines and general acceptance of the fact that controlled parentage was practical in developing commercial hybrids for use by farmers, there has been a rapid development in cooperative programmes involving entomologists, plant breeders, physiologists, chemists and soil specialists, to discover insect resistance in inbred lines now in use

and new germ plasm possessing insect resistance, to determine the basic principles responsible for resistance and to combine resistance to more than one species of insect.

The insects with which investigations on the development of resistance in maize have been mainly concerned are *Calandra (Sitophilus) oryzae*, L., the chinch bug [*Blissus leucopterus*, Say], the corn leaf aphid [*Aphis maidis*, Fitch], the corn earworm [*Heliothis armigera*, Hb.], *Pyrausta nubilalis*, Hb., *Diabrotica duodecimpunctata*, F., and grasshoppers.

PACKARD (C. M.). **Breeding Wheat and Alfalfa for Resistance to Insect Attack.**—*J. econ. Ent.* **34** no. 3 pp. 347–352, 38 refs. Menasha, Wis., 1941.

Attempts made in the United States to find or produce wheat varieties resistant to insect injury, which have been concerned mainly with resistance to the hessian fly, *Mayetiola (Phytophaga) destructor*, Say, are reviewed. The first systematic observations revealed that a number of wheats showed decided resistance to *M. destructor*, that none of these was commercially desirable, except in restricted areas, and that, with most of them, fly resistance varies in different localities. The results of intensive breeding work during the past decade, involving the testing of thousands of varieties and selections, show that resistance can be successfully transferred from spring to winter wheats and from winter to spring wheats, that the factors for resistance are transmitted in accordance with genetic laws and are not linked with undesirable characters, that resistance to diseases as well as to the fly can be combined in a single homozygous line and that desirable commercial wheats possessing high resistance to the fly and to the common fungous diseases can be produced. Little is known about the particular plant characters responsible for resistance to *M. destructor* in wheat, but unattractiveness of the plants to ovipositing flies, low survival and inhibited development of feeding larvae and the ability of the plant to withstand larval feeding are all known to be involved. The investigations have been complicated by the difficulty of obtaining consistently significant infestations in the test plots, the occurrence of distinct biological strains of the fly, and the variation of the resistance of many strains of wheat with the environment. It appears that, although the development of highly resistant, commercially desirable varieties is practicable, providing a more efficient and economical method of preventing losses due to the fly than any previously available, the perfection of completely immune varieties may not be attainable, since resistant varieties may be fertilised by susceptible ones grown in the neighbourhood or, if they are grown in large acreages, flies capable of surviving on them may increase until the resistance of the wheat is ineffective. Other insects to which resistance in wheat has been observed include *Blissus leucopterus*, Say, *Meromyza americana*, Fitch, *Oscinella frit*, L., *Cephus cinctus*, Nort., and *Harmolita tritici*, Fitch.

Recent observations have shown resistance to *Empoasca fabae*, Harr., and *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) in certain varieties and selections of lucerne. Resistance to *M. onobrychis* appears to be transmitted in accordance with genetic laws, and the selection or breeding of resistant varieties offers a possible method of control. The difficulties to be expected in breeding lucerne are discussed.

BAILEY (S. F.). **Breeding Vegetables for Resistance to Insect Attack.**—*J. econ. Ent.* **34** no. 3 pp. 352–358, 46 refs. Menasha, Wis., 1941.

As a result of the diversity of vegetables and the transient nature of such annual crops, necessitating only temporary insect control measures, there is a lack of fundamental knowledge of the factors involved in resistance to insect attack and their inheritance. Information in this respect is more complete for the potato and onion than for other vegetable crops. The occurrence of resistance in a number of crops is discussed, mainly from the literature, and it is pointed out that with each individual crop-insect association, different factors or combinations of factors appear to be involved. The type and strength of insect mouth-parts, oviposition responses, toxic or distasteful substances in the plant fluid, rapidity of growth of the plant and recovery from injury, as well as type of growth and thickness of epidermis, all affect insect activity.

PAINTER (R. H.). **The economic Value and biologic Significance of Insect Resistance in Plants.**—*J. econ. Ent.* **34** no. 3 pp. 358–367, 4 figs., many refs. Menasha, Wis., 1941.

Studies on the differential injury by insects to plant varieties have been carried out for a number of years, and attempts have been made to analyse the factors concerned and to utilise the information obtained in insect control. It is pointed out that insect resistance in plants must be adjusted to the control of specific insects and to the plant improvement programme of particular crops, and that since the development of resistant varieties usually requires a long period of controlled experiments and plant breeding, chemical control will continue to be necessary for the immediate protection of the crops. The results already obtained, however, indicate that the development of resistance in plants is a valuable addition to the methods of controlling pests; since the degree of resistance varies widely between crops and in relation to the different insects attacking them, it may be used as the principal method of control, as in the case of *Phylloxera vitifoliae*, Fitch, attacking grape-vine, as an adjunct to other control measures, for example, to protect sorghum and maize from attack by chinch bugs [*Blissus leucopterus*, Say] of the second and third generations, against which the barriers that are necessary for the protection of the young plants are useless, or to reduce the risk of distributing new varieties and species of plants that are more susceptible to insects than those already grown. Data on the possible effects of the resistance of the crop plant or of an alternative food-plant on the general population level of the insect involved, on the establishment of insect parasites of the pest, and on its chemical control are surveyed, and the interrelations of factors affecting insect resistance in plants and the permanence of such resistance are discussed. In conclusion, it is pointed out that the growing of resistant varieties, like the use of parasites and predators, costs little, and that, unlike some other measures of control, its effectiveness does not depend on regional cooperation. In some cases it permits some control of a pest at a time when no other known means of control are practicable, and it may, when necessary, be combined effectively with most other control measures. Some facts of general biological significance observed in the course of the studies are briefly reviewed.

BUCHANAN (W. D.). **Experiments with an Ambrosia Beetle, *Xylosandrus germanus* (Blfd.).**—*J. econ. Ent.* **34** no. 3 pp. 367–369, 2 refs. Menasha, Wis., 1941.

Attempts were made in 1940 to develop a laboratory technique for infesting sections from diseased or healthy elm trees with the Scolytid, *Xyleborus* (*Xylosandrus*) *germanus*, Bldf., which has been shown to transmit the fungus, *Ophiostoma* (*Ceratostomella*) *ulmi*, that causes Dutch elm disease [*R.A.E.*, A **29** 365]. The beetles oviposited in sections that had been stripped of bark, and the new generation began to emerge after about two months, but though they frequently entered the ends of sections bearing bark, they did not oviposit and seldom bored through the bark to the sapwood. When the outer bark or both the outer and inner bark were removed from small areas on the trunks of living elms in the field, the beetles bored into these areas but did not oviposit in them; they did not attack bruised or untreated areas. On 1st July, strips of the outer bark were removed from 13 elm trees, and muslin cages, each of which contained 25 adults artificially contaminated with *O. ulmi*, were attached to the trunk over both stripped and untreated wood; by 4th September, external symptoms of the disease had developed in every tree, and *O. ulmi* was isolated from twigs taken from the crowns. Since no trunk or twig-crotch injury due to *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., or *Scolytus multistriatus*, Marsh., was observed, and bands of colour extended up from the treated area in all the trees examined, and since adjacent trees showed no symptoms, it is concluded that *X. germanus* had infected the trees. No oviposition occurred. Larvae of *X. germanus* that were removed from brood chambers in elm and red pine (*Pinus resinosa*) gave rise to adults after they had been fed for over a month on any one of the following fungi: *O. ulmi* from elm; *Ceratostomella pluriannulata* taken from perithecia surrounding the larvae in brood chambers in red pine; an unidentified fungus from a brood chamber in elm; and a species of *Pestalozzia* separated from a mixture of fungi and bacteria in an agar plate on which an adult from elm had crawled. The injection of ethyl alcohol into living elm trees was found to render them attractive to adults of *X. germanus*.

COLLINS (C. W.). **Studies of Elm Insects associated with Dutch Elm Disease Fungus.**—*J. econ. Ent.* **34** no. 3 pp. 369–372, 3 refs. Menasha, Wis., 1941.

A brief account is given of experiments carried out in six localities in New Jersey during 1935–40 on the relation of insects to *Ophiostoma* (*Ceratostomella*) *ulmi*, the fungus that causes Dutch elm disease. In 1936, all species of insects attracted to felled healthy elm trees were collected during the active season and some were found to be contaminated with the fungus [*R.A.E.*, A **26** 325], but only the major vectors, *Scolytus multistriatus*, Marsh., and *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., were included in the collections of 1937–39. Many more adults of *S. multistriatus* than of *H. rufipes* were collected, and the percentages infected were 6.9, 5.8, 7.7 and 5.71 and 4.3, 2.4, 3.3 and 0.7 in the four years, respectively.

S. multistriatus is the most important vector of *O. ulmi* in the greater part of the area in which the disease occurs. It introduces the fungus into living trees by means of crotch feeding or by boring into the trunk or limbs of trees to the xylem. In an area heavily infested with *H. rufipes*, but in which *S. multistriatus* also occurs, examination in July

1938 of 18 normal elms that had been felled and barked showed 55 tunnels reaching the xylem in 13 trees, of which 18 were caused by *H. rufipes* and 15 by *S. multistriatus*, while 22 were unclassified. Laboratory and field observations have shown that *H. rufipes* is a fairly important vector, particularly where the fungus has become established and *S. multistriatus* does not occur. Overwintering adults infect normal living elms to only a limited extent, probably because they do not reach the newly formed spring vessels [cf. 28 574], but a higher proportion of infection is believed to be caused by beetles that mature from overwintered larvae and emerge after the spring vessels are functioning, or after sap has begun to move in the trees.

Reference is made to the experimental transmission of the fungus by two other Scolytids that occur in New Jersey [see preceding abstract and 29 119] and to the question of the importance of *Eutetrappa* (*Saperda*) *tridentata*, Ol., as a vector [cf. 28 341, 479; 29 627]. *O. ulmi* has been isolated from adults of this Lamiid that emerged from diseased elm wood in cages, and one contaminated adult has been taken in the field, but laboratory experiments have shown that it does not transmit the fungus effectively. Contaminated adults transmitted it by their feeding on the midribs and veins of the leaves or the succulent growth, but infection was always extremely localised. Natural elm stumps left in the process of eradicating the disease in areas where there were concentrations of trees of low value are attractive to *E. tridentata*, ambrosia beetles and some other species associated with Dutch elm disease and might act as reservoirs of the fungus. Artificially contaminated adults of *E. tridentata* were, therefore, caged on such stumps in 1938 and 1939, and 132 adults that emerged from 27 stumps in 1940 were cultured, with negative results. Since the females do not usually insert the eggs deeper than the inner bark, they are unlikely to cause an accumulation of fungus in dead wood.

A spray consisting of four parts by volume of water and one of orthodichlorobenzene, with an emulsifier, killed eggs, larvae and pupae of both *S. multistriatus* and *H. rufipes*, and one of four parts light fuel oil and one of orthodichlorobenzene, applied to freshly cut elm logs in May repelled both species for the remainder of the season [cf. 29 427], though untreated logs were heavily attacked. The most effective chemicals for killing elm trees and preventing breeding by bark-beetles proved to be sodium arsenite at a dosage of 0.5 gm. per inch diameter at breast height, copper chloride or copper nitrate (15 gm.), ammonium bifluoride (30 gm.) and copper sulphate or zinc chloride (60 gm.), applied in water by means of a chisel-cut girdle and water-tight collar [cf. 28 336-337].

KNOWLTON (G. F.). **Insect Food of Bullock Oriole.**—*J. econ. Ent.* **34** no. 3 p. 372. Menasha, Wis., 1941.

Lists are given of noxious insects identified in the stomach contents of three examples of *Icterus bullocki*, collected in Utah. One stomach contained 2,310 Aphids and another 149, most of them of economic importance.

HETRICK (L. A.). **Life History Studies of *Neodiprion americanum* (Leach).**—*J. econ. Ent.* **34** no. 3 pp. 373-377, 4 figs. Menasha, Wis., 1941.

For a number of years, a sawfly, identified as *Neodiprion americanus*, Leach, has defoliated pines in scattered areas in eastern Virginia.

Pinus taeda is its preferred food-plant, and *P. echinata*, which is less common, is infested where it occurs with *P. taeda*, but *P. virginiana* is not usually attacked, although some oviposition and larval feeding have been observed on it. Defoliation has occurred in closed stands, but is commoner in areas that are understocked with pine, and where the trees retain their lower branches. Most infestations were confined to areas with fine sandy soils. All stages of this sawfly are briefly described. The adults emerge in October, and the females insert their eggs in rows in the needles of the top branches of pine trees 20-30 feet tall, the average number of eggs per female being 106. The larvae hatch in late April or early May, and complete their feeding in about 30 days. Early in June, the prepupae penetrate the soil to a depth of several inches and spin cocoons. Pupation takes place late in September, the pupal stage lasts about a fortnight, and the adults remain in the cocoons for about a week before emerging from the soil. Some individuals do not pupate until September of the following year.

An average of more than six cocoons per square foot was found in the infested areas in the autumn of 1939 and 1940. Approximately 50 per cent. of those examined were parasitised by insects, another 10 per cent. were diseased, and about 18 per cent. contained prepupae that would have remained in the soil into the following year. Full-grown larvae in the field and in the insectary died in May of both years, apparently as a result of bacterial or virus infection, and prepupae were killed by a disease that appears to be caused by a fungus. The most important of the parasites bred from the cocoons was *Exenterus flavissimus*, Cushm., the adults of which emerge in April and May and are abundant throughout the feeding period of the sawfly larvae. The others comprised *Stylocryptus subclavatus*, Say, the Bombyliid, *Anthrax sinuosa*, Wied., which was very abundant in infested areas and was reared from many cocoons, and the Tachinids, *Spathimeigenia spinigera*, Tns., and *Phorocera claripennis*, Macq., which were not numerous. Adults of the sawfly, particularly the females, were attacked by predacious bugs and spiders.

Since the sawfly larvae eat only the old needles, the pines are not killed by repeated defoliation, but their wood production is reduced. No outbreaks of bark-beetles were observed after the defoliation. In tests on a small scale, sprays of 3 lb. lead arsenate per 100 U.S. gals. or 8 lb. calcium arsenate per 100 U.S. gals. with calcium caseinate as an adhesive, applied when the larvae were young, gave effective protection, and these sprays should be useful for ornamental trees. Investigations made in the winter of 1939-40 showed that cutting infested pine trees in winter causes the desiccation of the sawfly eggs in the needles. Adequate inspection and cutting before the time of hatching during two successive winters would be necessary, in order to destroy the eggs of the individuals that spend a second season in the soil.

PARMELEE (F. T.). **Longhorned and flatheaded Borers attacking Fire-killed coniferous Timber in Michigan.**—*J. econ. Ent.* **34** no. 3 pp. 377-380, 4 refs. Menasha, Wis., 1941.

Wood-boring insects, chiefly beetles, often do a great deal of damage to dead standing or fallen timber that would otherwise be saleable,

and fungi that reach the heartwood through borer tunnels may render it worthless even for firewood. Investigations were, therefore, carried out to determine which species damaged fire-killed coniferous timber in Michigan and the effect of heavy concentrations of such secondary forest insects within a burned-over area on the surrounding uninjured trees. The degree of infestation of storm-felled conifers and slash from cuttings was compared with that of fire-scorched timber from the same locality, in order to determine the effect of scorched bark on oviposition. In 1937, recently cut logs and branches of white pine (*Pinus strobus*), half of which were scorched by burning kerosene smeared over the bark, were exposed in a sunny position from 13th May to 20th September and subsequently caged. Four species of Longicorns and a Buprestid were reared from the wood, most of the serious heartwood damage being caused by the Lamiid, *Monochamus scutellatus*, Say. The Cerambycid, *Asemum moestum*, Hald., reached the heartwood of the branches, but was too scarce to be important. The superficial burning appeared to have a repellent effect.

In November 1938, heavily infested timber of three species of pines was obtained from an area that had been cut over during the previous winter; all slash had been left in the clearings, and a small fire that occurred in May had destroyed some of the slash and killed a few of the surrounding trees. In addition, infested timber of *P. banksiana*, balsam fir (*Abies balsamea*) and larch was collected from other localities. In October 1939, timber was obtained from nearly 30,000 acres of coniferous forest that were burnt in May 1939, most of the trees being killed or severely injured. *P. banksiana* was the dominant species over the whole area, but other native conifers were generally distributed. Lists are given of the 7 Longicorns and 4 Buprestids reared from the material obtained in 1938 and the three Longicorns reared from that obtained in 1939. In both cases *M. scutellatus* was the most injurious. Fungous infection in the heartwood of logs was observed only where such regions were penetrated by the tunnels of this Lamiid. In neither year were uninjured trees near the burnt area affected as a result of the heavy concentration of secondary wood-destroying insects within it, though some injured trees that might have recovered were killed by bark-beetles. The results obtained from the 1938 material confirmed that fire-killed timber does not necessarily attract ovipositing beetles because of the effect of the burning. Parasites and predators did not appear to be of much importance in destroying wood-boring larvae in 1939. Woodpeckers were numerous, but probably exerted little control. *Ephialtes* (*Ichneumon*) *mesocentrus*, Grav., was the most numerous parasite of *Monochamus*.

Timber is most attractive to wood-boring Coleoptera during the first year after the death of the trees, and these borers will not usually reinfest trees from which they have emerged as adults. Certain species that prefer wood in a more advanced stage of decay are of little importance. Injury is confined mainly to the trunks and larger branches. Larval counts and adult emergence records from fire-killed timber in Michigan indicated that *Pinus strobus* is the favourite food-plant for *Monochamus* as well as other wood-boring Coleoptera and that *P. resinosa* is much less heavily infested than other conifers. Under normal conditions in Michigan, the period of development of *M. scutellatus* is one year, but individuals developing under adverse conditions of moisture or light may require a much longer time.

MUIRHEAD (D. M.). **A Beetle Control Problem in Timbers of the Old South Meeting House.**—*J. econ. Ent.* **34** no. 3 pp. 381–383, 3 figs., 3 refs. Menasha, Wis., 1941.

A detailed account is given of the treatment successfully used to eradicate an infestation of *Xestobium rufovillosum*, DeG., discovered in 1937 in old oak timbers in the tower of a building in Boston, Massachusetts. It consisted in providing adequate ventilation in the tower to reduce the relative humidity and so prevent decay, cleaning the timbers thoroughly, removing frass from the galleries of the beetle by suction, and treating the wood first with orthodichlorobenzene and then with a light creosote, both of which were forced into all galleries, crevices and peg holes under pressure and applied to all surfaces with a spray gun.

FELT (E. P.) & BROMLEY (S. W.). **New and unusual Shade Tree Pests.**—*J. econ. Ent.* **34** no. 3 pp. 383–386, 1 ref. Menasha, Wis., 1941.

Young larvae of *Olene basiflava*, Pack., were observed on slippery elm [*Ulmus fulva*] and white oak [*Quercus alba*] at Stamford, Connecticut, in August and October 1938; this Lymantriid, which also feeds on other oaks, beech, flowering dogwood [*Cornus florida*], pecan and hickory, was reported from various localities in this area. The small larvae left the foliage in early September and assembled on the rough bark of the larger branches and trunk in unprotected clusters, in which they overwintered. In spring, they began to feed on the young leaves as they pushed out of the bud, mainly on the lower branches. When these are defoliated, probably about the middle of May, the larvae scatter to higher branches, where their feeding results in ragged leaves. They become full-grown about mid-June and spin loose cocoons on the rough bark of the tree; the adults emerge between 10th July and 9th August. The eggs are deposited in oval clusters of about 250. Oviposition was observed between 14th and 18th July, and hatching on 27th July. Several parasites, including *Tachina* (*Exorista*) *larvarum*, L., were reared. The Notodontid, *Symmerista albifrons*, S. & A., was exceptionally abundant in September 1940 on several species of oak, beech, chestnut and birch; it was reported from a number of localities in southern New England. *Ennomos subsignarius*, Hb., was extremely numerous on maple in a large swamp in Massachusetts in midsummer, when several hundred acres were defoliated by this Geometrid [cf. *R.A.E.*, A **28** 645]. Red maple [*Acer rubrum*] was most severely attacked, but there was some feeding on white oak, *Viburnum*, beech, elm and goldenrod. Leaves of apple and hazel [*Corylus*] in New York were attacked by the Jassid, *Phlepsius ishidae*, Mats., which has been observed in a number of localities in the north-eastern United States since 1919.

Hylobius radialis, Buchanan, is becoming somewhat injurious in south-western New England and south-eastern New York [cf. **25** 438; **26** 18], and rather serious damage occurred in New Canaan, Connecticut, in 1939, and in Greenwich and Stamford, Connecticut, in 1940. In the first case, a number of Austrian pines [*Pinus nigra* var. *austriaca*] with trunk diameters of 6–8 inches were killed, and 10 examples of *H. radialis* were bred from the stumps; full-grown larvae were observed on 29th June, and three adults were alive on 24th December, indicating

that they would hibernate. From five pine stumps at Greenwich, four examples of *H. radialis* and 36 of *Pissodes approximatus*, Hopk., were reared; it is probable that the feeding of *Hylobius* produced conditions attractive to *Pissodes*. Experiments on the feeding of *Scolytus multistriatus*, Marsh., on sprayed and unsprayed elms, begun in 1937 [26 547], were continued in 1940, when two small elms in pots were artificially infested with 44 adults each between 6th and 20th June, after a spray containing 6 lb. lead arsenate and $\frac{1}{2}$ lb. spreader per 100 U.S. gals. water had been applied to one of the trees and allowed to dry. Examination on 1st July showed four crotch-feeding punctures on the sprayed tree, and 44 on the unsprayed tree. In 1939, a general fungous infection developed in a large population of *Toumeyella liriiodendri*, Gmel. (tulip-tree scale) that has been present on a small tree at Stamford for several years, and larvae of *Chilocorus stigma*, Say (*bivulnerus*, Muls.) were so numerous that they practically eliminated the infestation.

Records are given of a number of gall-forming insects, including a Cecidomyiid, possibly *Rhabdophaga cornuta*, Walsh, which caused serious injury to black willow [*Salix nigra*] in localities in Connecticut and New Jersey. Trees 15–25 ft. in height and 5–9 ins. in diameter had been so seriously affected over a number of years that about half of them were dying or dead. Infestation was practically confined to four-year-old twigs $\frac{1}{4}$ inch in diameter, the sapwood of which was thickly pitted with larval cells, and younger wood beyond the injured areas was killed. Adults, as well as a number of parasites, were reared in the latter part of May. Spraying with a mixture of nicotine, soap and molasses, early in May, is a promising control measure.

NEISWANDER (C. R.). *Coryphista meadii* (Packard), a new Pest of Japanese Barberry.—*J. econ. Ent.* **34** no. 3 pp. 386–389, 4 figs., 6 refs. Menasha, Wis., 1941.

Early in July 1940, hedges of Japanese barberry (*Berberis thunbergii*) at Wooster, Ohio, were almost completely defoliated by larvae of *Coryphista meadii*, Pack., a Geometrid not previously recorded east of the Rocky Mountains. About 10 per cent. of the adults reared belonged to the light form (*badiaria*, Hy. Edw.). The area of infestation in Ohio in 1940 was found to cover more than half the State, and the larvae were taken on *B. thunbergii* and three varieties of it, and on *Mahonia* sp. All stages were present until mid-October, and larvae continued to feed in considerable numbers until 5th November, after which only pupae were found. The eggs were usually deposited singly on the lower surface of the leaves, but sometimes on the upper surface or on the petioles, twigs or spines. The larvae feed on the edges of the leaves during the evening, remaining concealed among litter or dead leaves during the day, until they are fully grown, when they construct cocoons, usually in the litter on the surface of the soil at the base of the plant, but sometimes in shallow soil crevices or among dead leaves lodged in the axils of branches. The egg, larval and pupal stages lasted 3–4, 12–16 and 7–13 days, respectively, during the summer, and there appeared to be four or five overlapping generations in the year.

Two Tachinid parasites, determined as *Madremyia saundersi*, Will., and an undescribed species of *Phrynolydella*, and three Ichneumonids,

identified as an apparently undescribed species of *Amblyteles*, *A. duplicatus*, Say, and *Pimpla* (*Ephialtes*) *aequalis*, Prov., were reared from the pupae. The Pentatomid, *Podisus maculiventris*, Say, was observed preying on the larvae. A spray of lead arsenate (3 lb. per 100 U.S. gals. water with or without a spreader) and a dust of lead arsenate and talc (1 : 4), applied in August, both gave effective control of the larvae and protected the plants for the remainder of the season.

HOLWAY (R. T.). **Tube-building Habits of the Eastern Subterranean Termite.**—*J. econ. Ent.* **34** no. 3 pp. 389–394, 4 figs., 2 refs. Menasha, Wis., 1941.

The following is substantially the author's summary of this account of observations in New England on the use by *Reticulitermes flavipes*, Kollar, of shelter tubes or runways, an understanding of which is of fundamental importance in the application of control methods. Analysis of termite attacks on buildings and results of laboratory experiments are in agreement with the reports of others that subterranean termites of the genus *Reticulitermes* rarely, if ever, construct tubes upward over foundation walls in the open. The cases observed in which such activity has occurred have resulted from excessively large colonies that developed where there was wood in the ground adjacent to the foundation walls. In dark, confined places, such as basementless areas, *Reticulitermes* may build tubes over foundation walls in order to reach wood above. The probability or frequency of this activity depends upon such factors as the relation of termite population to size of area, the presence of wood adjacent to the wall, and ventilation. The majority of tubes seen on foundation walls in the eastern United States are constructed downwards and not upwards. Under special conditions, termites may reveal unusual types of activity, such as travelling for many hours without tubes, constructing tubes from both ends, or building up many feet in the open.

DOMINICK (C. B.) & WENE (G.). **Notes on the Hibernation of the Tobacco Flea Beetle and on the Parasite, *Microctonus epitricis* (Vier.).**—*J. econ. Ent.* **34** no. 3 pp. 395–396, 2 refs. Menasha, Wis., 1941.

Studies on the hibernation of *Epitrix parvula*, F., in Virginia showed that, although many adults leave the tobacco fields at harvest [cf. *R.A.E.*, A **28** 172; **29** 200], some continue to feed on shoots from old tobacco stalks until the plants are killed by frost, and many of these hibernate in the tobacco fields. Data, obtained by keeping samples of soil and surface debris, taken from the base of the plants, in a warm room and collecting the adults that became active, indicated that more passed the winter in the soil below the protective layer of vegetable debris than in the debris on the surface. Forty-three flea-beetles were obtained from 15 samples collected on 20th December 1939, whereas only seven were recovered from 20 samples collected on 1st April 1940, after an unusually severe winter. Beetles placed in cages over natural litter at the edge of a wooded area in October 1938 left their hibernating quarters between 21st March and 26th May; the percentage that survived ranged from 1.3 to 5.1 in six cages, but reached 30 in the seventh. The survival would probably have been greater under natural conditions.

Parasitism of the adults of *E. parvula* by the larvae of the Braconid, *Microctonus epitricis*, Vier., in five localities varied from 6.01 to 25.4 per cent. in collections made between 22nd July and 13th August, and from 6.4 to 13.0 per cent. in those made between 19th and 24th August. Apparently only one parasite larva develops in each host, which it leaves before pupating.

DOMINICK (C. B.). **The Tobacco Flea Beetle in abandoned Plant Beds.**—*J. econ. Ent.* **34** no. 3 pp. 397–400, 1 fig., 1 ref. Menasha, Wis., 1941.

Investigations on the importance of tobacco seed beds as breeding places for *Epitrix parvula*, F., early in the season, carried out in Virginia in 1938–40, showed that immature stages were most abundant in abandoned beds in the first half of June, though breeding continued until October, when the observations were concluded. The data indicate that the overwintered beetles deposit large numbers of eggs when not controlled and that these develop into a large first generation of adults in the seed beds. It was found that emerging beetles were active from 15th June until observations on them were discontinued on 15th August, and that after they had fed for several days they migrated to neighbouring tobacco fields. Treating the soil of abandoned beds with dichlorethyl ether at the rate of 30 cc. in 1 U.S. gal. water per square yard in July, immediately after transplanting, gave a high mortality of the immature stages; the late stages, which are free in the soil, were more susceptible than the younger larvae, which feed largely within the roots or in tender stems above the ground. It was necessary to destroy the plants, either before the treatment or 7–10 days after it to prevent further breeding and emergence of the surviving insects; the treatment caused some injury to the roots and stems, but did not kill the plants. Owing to the expense and labour involved, this treatment is not practicable for the average grower, and tests of cultural practices were carried out in 1940. All the plants were removed from the soil on 10th June, and their roots were exposed to the sun outside the beds; the soil was thoroughly ploughed and disked and each area was sown with garden crops. On 16th June, when the insects were abundant in untreated beds, none was found in soil samples from the cultivated ones.

WATTS (J. G.). **A Progress Report on Tomato Fruit Worm Studies.**—*J. econ. Ent.* **34** no. 3 pp. 400–405, 3 figs. Menasha, Wis., 1941.

In 1940, field experiments on the control of *Heliothis armigera*, Hb., on tomato were begun in South Carolina, where effective control of the first few pickings of the spring crop is of outstanding importance [cf. *R.A.E.*, A **30** 42].

All insecticides were applied on 21st and 25th May and 1st, 8th, 15th and 20th June; the fruit had just begun to set and the plants had a spread of about 12 inches at the time of the first application. Newly hatched larvae were first found on 16th May. Kaolin containing 10 per cent. cottonseed meal was used as the diluent for the cryolite and arsenate dusts. The most efficient were 90 per cent. synthetic or natural cryolite, undiluted calcium and lead arsenates and 50 per cent. basic copper arsenate; they reduced the percentages of tomatoes infested to 2.8, 3.8, 3.9, 4.6 and 4.3, respectively, as compared with

20.9 on untreated plants. Dusts containing 50 per cent. lead or calcium arsenate appeared to be slightly more effective than 50 or 30 per cent. cryolite dusts, which were approximately equal in effectiveness. Basic copper arsenate was more effective at 50 per cent. than undiluted, owing to improved dusting quality, but the other arsenates were more effective undiluted. The percentage of fruits infested on the plots treated with cubé (5 per cent. rotenone) diluted with kaolin containing 4 per cent. cottonseed oil to contain 1 per cent. rotenone was increased to 30.6, probably because *Protoparce* (*Phlegethontius*) *sexta*, Joh., and *P. (P.) quinquemaculata*, Haw., defoliated the untreated plots extensively, making them less attractive to ovipositing females of *H. armigera*. Baits containing 10 per cent. synthetic cryolite, calcium arsenate or lead arsenate in maize meal gave 5.7, 5.1 and 7.3 per cent. infested fruit, and were definitely superior to dusts containing 10 per cent. lead or calcium arsenate. Sprays containing 8 lb. calcium arsenate or lead arsenate, each with 8 lb. bentonite, per 100 U.S. gals. water reduced infestation by about 75 per cent. and were superior to one in which synthetic cryolite at the same rate was substituted for the arsenical. Though there was little difference in the percentage of fruit infested after the application of dusts containing 50 per cent. natural cryolite in nine different diluents, there was a tendency for moderately good adhesives with superior dusting qualities to give better control than good adhesives with only moderate dusting qualities. Screened cottonseed meal and talc, which was somewhat less adhesive, were the most effective of the diluents tested; bentonite was the most adhesive, but is too heavy to use freely in dust mixtures. Kaolin was only moderately effective, but was used extensively because of its cheapness and availability. As any interval between insecticidal applications and picking is impracticable in schedules for the control of *H. armigera* on early tomatoes in South Carolina, the fruits were analysed for residues of arsenic, lead and fluorine. Only one sample exceeded the arsenic tolerance (0.025 grain As_2O_3 per lb. fruit), none exceeded the lead tolerance (0.05 grain) and only three the fluorine tolerance (0.02 grain). When each fruit was wiped with a piece of dry cheesecloth, none of the samples exceeded the tolerance.

KERR JR. (T. W.). **Sand-arsenical Mixtures for controlling White Grubs and their Effect upon the Growth of Strawberries.**—*J. econ. Ent.* **34** no. 3 pp. 405–411, 4 figs., 4 refs. Menasha, Wis., 1941.

An account is given of investigations in New York on the effect of mixtures of different proportions of lead arsenate or magnesium arsenate and sand in retarding the growth of four varieties of strawberry during the early part of the season. Earlier work had shown that a mixture containing 1 lb. lead arsenate to 20 lb. sand was the most effective for the control of larvae of *Lachnosterna* (*Phyllophaga*) spp. on strawberry [cf. *R.A.E.*, A **29** 259], and the results obtained in these investigations indicate that the runner production of plants treated with this mixture is not significantly different from that of untreated plants.

GRAY (K. W.) & SCHUH (J.). **A Method and Contrivance for sampling Pea Aphid Populations.**—*J. econ. Ent.* **34** no. 3 pp. 411–415, 3 figs. Menasha, Wis., 1941.

The following is substantially the authors' summary. A method of sampling populations of *Macrosiphum onobrychidis*, Boy. (*pisi*, Kalt.)

on peas, by means of which two or more persons could sample the same area and obtain equivalent results, was developed in Oregon. It consisted in plucking the top six inches of the plants at random in an area, shaking the Aphids from the plant tips and counting them. A sampling can, which consisted of a funnel covered with coarse screen mounted below a gas chamber, was used to separate the Aphids from the plant parts. The plant tips and Aphids were placed in the gas chamber, which contained fumes of methyl-iso-butyl ketone, and left for five minutes. The fumes caused the Aphids to drop from the plant parts. The can was given 50 shakes, causing the Aphids to fall through the screen and be caught in a carton at the bottom of the funnel. The Aphids were counted in the laboratory later. One person, without previous experience, could take 40 samples by this method and count the Aphids in about eight hours.

AU (S. H.). *Megamelus davisi* infesting Water Lily in Hawaii.—*J. econ. Ent.* **34** no. 3 p. 415. Menasha, Wis., 1941.

Megamelus davisi, Van D., was observed on water lily (*Nymphaea*) in Oahu in February 1941; it had, presumably, been introduced with plants from aquatic gardens in the United States. There was no apparent damage to old-established plants, but infested shoots less than six months old produced a poor growth of leaves and inferior flowers. In view of the restricted choice of food-plant and the small acreage involved, it is hoped that clean cultivation will eradicate this Delphacid.

LANGFORD (G. S.), WHITTINGTON (F. B.), VINCENT (R. H.) & CORY (E. N.). Cooperative Japanese Beetle Work in Maryland.—*J. econ. Ent.* **34** no. 3 pp. 416-418. Menasha, Wis., 1941.

The work carried out against the Japanese beetle [*Popillia japonica*, Newm.] in Maryland since 1938 is reviewed [*cf. R.A.E.*, A **28** 521; **29** 504; **30** 124, etc.]. Biological control by the introduction of milky disease and parasites is of major importance, but slow in taking effect, and traps have been operated extensively. Sprays and dusts are used, but are too expensive for most farmers; soil treatment of lawns is recommended in towns and cities. Diffusion of information on the growing of resistant crops and the adjustment of planting dates has been widespread. It is pointed out that the marginal period for planting to avoid injury by both the beetle and frost is narrow; there appears to be no planting date that will ensure freedom from both types of damage in all years. Favourable planting dates for maize in north-eastern Maryland are suggested. Lead arsenate with an adhesive was the most effective of the 18 spray mixtures tested in 1940, and derris or rotenone dust with an adhesive was the best of the non-arsenical materials. Heavy applications of a dust of hydrated lime help to protect maize and other plants.

SNAPP (O. I.). Value of the Petal-fall Application of Lead Arsenate in controlling the Plum Curculio on Peach in the South.—*J. econ. Ent.* **34** no. 3 pp. 418-419, 1 ref. Menasha, Wis., 1941.

The value of an application of lead arsenate at petal-fall to peach trees for the control of *Conotrachelus nenuphar*, Hbst. [*cf. R.A.E.*, A **29** 198] was confirmed in experiments carried out in a commercial

orchard in Georgia in 1940, when the results of jarring during the period between petal and sepal fall showed that there were almost three times as many adults on unsprayed as on sprayed trees. The numbers of weevils removed from various parts of the orchard in eight jarrings between petal fall and the stone-hardening stage of the fruit are shown in a table; it was confirmed that the heaviest populations occur in the outer rows of trees or in those nearest to places of hibernation, and that regular jarring of these trees early in spring would hinder the dissemination of the weevils through the orchard.

WOODSIDE (A. M.). **Studies of Codling Moth Cocooning Habits.**—*J. econ. Ent.* **34** no. 3 pp. 420–424, 13 refs. Menasha, Wis., 1941.

In the course of studies of chemically treated strawboard bands as a supplementary means of controlling the codling moth [*Cydia pomonella*, L.] on apple, carried out in Virginia in 1937–40 [cf. *R.A.E.*, **A** **26** 507], numerous data were accumulated on the behaviour of the larvae in seeking for places in which to spin their cocoons. Bands impregnated with beta-naphthol caught 69–83 per cent. of the larvae that made their cocoons on mature, well-scraped trees, but were somewhat less effective on unscraped trees. Bands dipped in a mixture of oil and lampblack trapped more larvae than untreated ones but fewer than those treated with beta-naphthol. When two treated bands, separated by a barrier, were placed on the same tree, about 40 per cent. of the trapped larvae were caught in the lower band, from which it is evident that many of the larvae that leave the fallen fruits return to the tree to make their cocoons if there is not much litter beneath the trees.

On mature apple trees, about 70–88 per cent. of the larvae that were not caught in the bands made their cocoons on the branches, and more than half of them were in situations where they were safe from birds and could not be reached by scraping the trees. The distribution of the larvae on the trees was little changed by banding or scraping the trees, though the total number was greater on unbanded trees. Only 25 and 15 per cent. of the larvae removed from treated bands in the autumns of 1937 and 1939 completed their development, whereas the corresponding percentages for untreated bands were 62 and 59. Apparently only those larvae that entered the treated bands during the last few weeks that they were on the trees were able to complete their development, and it is unlikely that many of them would have survived if they had been left in the bands until spring. No adults emerged in cages placed over leaves raked up under heavily infested apple trees, and few emerged in cages placed over the soil under heavily infested trees.

PRATT (B. G.). **Control of Codling Moth with Arsenate of Lead and certain Forms of Rotenone and Pyrethrum.**—*J. econ. Ent.* **34** no. 3 pp. 424–426, 1 ref. Menasha, Wis., 1941.

The author states that a few years ago an insecticide known as D-X was evolved in which rotenone and pyrethrins are apparently enclosed together in globules of oil, which seems to have the effect of greatly increasing their activity and penetration and admits of their use with the milder alkaline sprays, such as lime-sulphur, flotation sulphur and standard sulphur fungicides, without affecting their toxic

properties, though they are still incompatible with spray materials of higher alkalinity, such as hydrated lime or home-made Bordeaux mixture. When D-X is combined with lead arsenate, the particles of the latter seem to become coated or impregnated with the rotenone and pyrethrins; this apparently increases the toxicity of both the contact and residual poisons, and there are indications that D-X forms such a close union with the lead arsenate that paralysis takes place quickly, even if the insect is able to discard a mouthful of the poison.

A single spray of D-X and lead arsenate protected apple and shade trees against the Japanese beetle [*Popillia japonica*, Newm.] for the entire season in Maryland in 1938, and successful results, of which a typical example is given, were obtained in orchard tests against first-generation larvae of the codling moth [*Cydia pomonella*, L.] on apple in several States over a period of two years.

GLEISSNER (B. D.) & WORTHLEY (H. N.). **Evidence for a third Brood of the Grape Berry Moth, *Polychrosis viteana* Clemens, in the Great Lakes Region.**—*J. econ. Ent.* **34** no. 3 pp. 426-431, 4 figs., 7 refs. Menasha, Wis., 1941.

The author draws attention to conflicting statements regarding the number of generations produced annually by *Polychrosis viteana*, Clem., on vines in the Great Lakes region of the United States and presents evidence gained from investigations in Erie County, Pennsylvania, in 1939 and 1940 that a partial third generation is produced each season in vineyards growing on the lighter soils, such as gravels, gravelly loams and sandy loams, but not, in some seasons at least, in vineyards on the heavier clay soils. The catches in bait traps in 1939 in a vineyard on heavy clay showed that adults of the overwintered generation were present from 7th June to about 20th July, and those of the first generation, which were nearly five times as numerous, during August; 50 per cent. of the moths had emerged by 3rd July and 21st August, respectively. The mid-point of abundance of first-generation moths in the insectary occurred about 11 days before the date indicated by the trap catches, partly owing to the presence in the collections of many larvae from vineyards on light soil. In 1940, bait traps in a vineyard on gravelly loam showed three distinct flight periods, the mid-points of emergence being about 18th June, 25th July and 5th September. The numbers caught were 136, 907 and 2,017, respectively. The emergence of the last generation was delayed by bad weather. Records of egg deposition by moths of the first and second generations showed oviposition peaks in early August and mid-September. Emergence records for each generation bred in cages confirmed those obtained in the field; in both cases, about 17 per cent. of the second-generation pupae hibernated. Larvae of the first generation were collected from a vineyard on clay soil for comparison, and the mid-point and peak of adult emergence in this case occurred 18 days later than in the case of those from the vineyard with light soil. The less advanced stage of development of the insects on heavy soils was confirmed by comparing those from random collections of grape clusters made in several vineyards on 14th August.

Since cocoon formation by second-generation larvae on the heavy soil began in late August, reached a peak one month later and subsided gradually, whereas that by third-generation larvae on the light soil began on 21st September and increased rapidly until checked suddenly

by cold weather on 14th October, after which it declined rapidly and ceased on 29th October, it seems evident that nearly all second-generation larvae on the heavy soil entered hibernation successfully, but many third-generation larvae on the light soil died without spinning cocoons. This may explain the common observation that infestations tend to persist in vineyards on clay soils, but are erratic in those on lighter soils. The effect of the type of soil on the microclimate of the cocoons and the importance of timing sprays accurately according to the conditions in the individual vineyards are discussed.

NORTON (L. B.) & HANSBERRY (R.). **Radioactive Tracer Methods for Determination of the Disposition of Arsenic in the Silkworm.**—*J. econ. Ent.* **34** no. 3 pp. 431–437, 4 figs., 7 refs. Menasha, Wis., 1941.

The authors describe an experiment designed to test the possibilities of radioactive arsenic for following the behaviour of arsenic in insects [*cf. R.A.E., A* **19** 343]. The technique employed in preparing the material for use is given in some detail, in view of the broad applicability of the radioactive tracer method to the solution of problems in insect toxicology, with shorter accounts of the methods of treating the insects and determining the arsenic content of the samples. Silkworms [*Bombyx mori*, L.] were used in all the experiments because of their size, ease of rearing and sensitivity to arsenicals.

Analyses of faeces, regurgitation, blood, gut and tissue samples showed that the initial elimination of arsenic is more rapid and complete for insoluble arsenates than for soluble ones; that the arsenates eliminated most completely tend to be least effective; that the elimination of arsenic once it is absorbed is very slow, but is greatest for the most completely absorbed arsenates; that the major part of the absorbed arsenic is found in the wall of the midgut and the transfer of arsenic through the gut to the rest of the body depends on the original composition of the arsenical; that the toxic effects of the arsenates are roughly correlated with the arsenic concentrations in the gut and other tissues, though certain exceptions are noted; and that the behaviour of the arsenates can be explained on the basis of absorption as complex ions. It is concluded that radioactive arsenic shows great promise as a tool for more accurate investigation of the toxicology of arsenic in insects.

O'KANE (W. C.) & SMITH (H. W.). **A new Fumigant, 1,1-dichloro-1-nitroethane.**—*J. econ. Ent.* **34** no. 3 pp. 438–439. Menasha, Wis., 1941.

Studies of the derivatives of the nitroparaffins having suggested the use of 1,1-dichloro-1-nitroethane as a fumigant for the control of insects, experiments with this compound were carried out over a period of two years. It is liquid at ordinary temperatures, but is readily vaporised without the application of heat and will pass out of an absorbent carrier relatively rapidly. It appears to be as safe to use as orthodichlorobenzene. The gas caused no damage to a number of furs, dyed fabrics and metals, with the exception of iron, which was corroded in an atmosphere of high humidity, nor to dry foods, grains and cereals; fresh fruit and plants in leaf were injured. It readily penetrated sealed packages of cereals and flour in sacks; the odour

disappeared rapidly from fumigated articles. At a temperature of 26°C. [78·8°F.], the dosages per 1,000 cu. ft. required to give complete kill of larvae of the yellow mealworm [*Tenebrio molitor*, L.] and adults of the confused flour beetle [*Tribolium confusum*, Duv.], rice weevil [*Calandra oryzae*, L.] and American cockroach [*Periplaneta americana*, L.] were 1½, 1, ½ and ¼ lb. for 2, 3, 4 and 8 hours, respectively, when the insects were freely exposed to the gas, and 3, 2½, 2, 1½ and 1 lb. for 4, 6, 8, 10 and 12 hours, respectively, when they were in 100-lb. bags of wheat.

GOULD (E.) & GEISSLER (G. H.). **Hibernating Codling Moth Larvae.**—*J. econ. Ent.* **34** no. 3 pp. 445-450, 3 figs., 12 refs. Menasha, Wis., 1941.

In the course of studies in West Virginia on practices that might supplement or replace spraying, which has not given satisfactory control of the codling moth [*Cydia pomonella*, L.] in heavily infested apple orchards for several years, data on the hibernating habits of the larvae, which are of importance in planning mechanical and other methods of control, were secured. Detailed observations on the larval population and its normal behaviour were carried out on a single apple tree during 1939, and records of hibernating larvae were taken from six other trees in December. The single-tree study showed that about half the larvae of a given population drop to the ground either free or in fruits, but no larvae were recovered from either soil or débris under any of the trees examined. The soil was compact, and there was little cover on it. It appears that a negligible proportion of the overwintering larvae hibernate in the débris on the ground, and these can be practically eliminated by keeping the growth of vegetation and the débris beneath the trees at a minimum. No larvae were found in fallen fruits, indicating that practically all the young larvae in the fallen fruits either leave them or are destroyed. Since no full-grown larvae were found on, in or near the ground under the trees examined in December, it is evident that those that do not ascend the trees and find hibernation quarters are destroyed by predators and other natural factors. The situations and abundance of overwintering larvae are determined largely by the availability of suitable cover. There was no apparent significance in the situation of the larvae recovered; the results indicate that they tend to find hibernating quarters by chance, wandering aimlessly until they reach a suitable site. Large numbers were found in the ends of fruit spurs and small twigs; approximately 31 per cent. were recovered from twigs and limbs less than four inches in circumference. Only 5·7 per cent. were recovered from the trunks and 7·4 per cent. from the main branches, probably owing to thorough annual scraping. Almost half of the larvae were concentrated in a few very favourable situations. Of the total seasonal larval population, about 28 per cent. were collected in bands on the trunk and main branches, 3 per cent. remained in the harvested fruit, 39 per cent. were destroyed by predators and other natural factors, 15 per cent. gave rise to moths during the season, 12 per cent. were unaccounted for, and only 3 per cent. overwintered on the trees. More than 60 per cent. of all surviving larvae were caught in trunk and branch bands. An overwintering population of 41 larvae per tree gave a first-generation infestation of 36·4 per cent. in 1940.

BARBER (G. W.). **Observations on the Egg and newly hatched Larva of the Corn Ear Worm on Corn Silk.**—*J. econ. Ent.* **34** no. 3 pp. 451–456, 1 fig., 3 refs. Menasha, Wis., 1941.

Descriptions are given of the egg of *Heliothis armigera*, Hb., of the process of hatching and of the behaviour of the larva on the maize silks from the time when it hatches until it begins to feed on silk at the tip of the ear. The average situation of the egg on the silk was 52.3 mm. beyond the tip of the husk. The average time between hatching and arrival of the larva at the tip of the ear was about 80 minutes. The newly hatched larvae feed very little on exterior silks, so that efficient control is unlikely to be obtained by applying insecticides to the exterior silks alone, but introducing the insecticides into the tip of the ear, where the larvae collect to begin feeding, shows promise as a control measure.

DAHM (P. A.) & KEARNS (C. W.). **The Toxicity of Alkyl Secondary Amines to the Housefly.**—*J. econ. Ent.* **34** no. 3 pp. 462–466, 2 graphs, 4 refs. Menasha, Wis., 1941.

As the object of this investigation was to study the relation between the molecular structure of synthetic organic compounds and their toxicity to insects, it was limited to a single homologous series of compounds, the alkyl secondary amines, the toxicity of which is assumed to be largely due to the presence of the secondary amino group, $-(NH)-$, so that variations in the toxicity of closely related compounds would be due to minor differences in the size and structure of the alkyl groups and not to the introduction of other functional groups that might contribute an additional toxic property to the molecule. The toxicity and rate of toxic action of 22 of these compounds to house-flies [*Musca domestica*, L.] were tested by the "large group" Peet-Grady method [cf. *R.A.E.*, B **26** 244, 245]. The compound N,n-hexyl-n-heptylamine was the most rapidly acting of the straight-chain alkyl secondary amines, as judged by the time required to produce approximately 95 per cent. knockdown, and was more toxic than any lower members of the series and equal or superior to any of the higher members. Straight-chain alkyl secondary amines with alkyl groups that were identical or differed by only one CH_2 group were more toxic than isomers in which the two alkyl groups differed by more than one CH_2 group. The substitution of branched-chain alkyl groups for one or both of the straight-chain alkyl groups produced a reduction in toxicity and a decrease in the rate of toxic action.

CHAMBERLIN (T. R.) & SEATON (L.). **Proportion of the Sexes in June Beetles in Wisconsin.**—*J. econ. Ent.* **34** no. 3 p. 467, 4 refs. Menasha, Wis., 1941.

The fact that light-traps usually catch more males than females of *Lachnosterna* (*Phyllophaga*) might suggest that the males are more numerous in nature. Collections of adults made by hand-picking or shaking from food-plants in southern Wisconsin in 1935–40, however, resulted in a total of 57,111 adults, of which 49.2 per cent. were males. There is some difference in the proportions of the sexes in the various species; they were about equally divided in *L. (P.) rugosa*, Melsh., there was a slight excess of males in *L. (P.) hirticula*, Knoch, and a somewhat larger excess of females in *L. (P.) fusca*, Froel. These three

species comprised 88 per cent. of all the beetles collected. All species of *Lachnosterna* in the same locality do not begin to emerge at the same time in the season. There is usually a tendency for males to be more abundant early in the season, for females to persist later, and for females to emerge and feed in greater numbers at lower temperatures than do the males during the preoviposition and early oviposition periods. In 1938, however, it was noted that the males of *L. (P.) ilicis*, Knoch, predominated as the season advanced.

PERSING (C. O.), BARTLETT (B. R.) & BEIER (R. L.). **Effect of pH on Toxicity of certain Antimony Compounds to the Greenhouse Thrips.**—*J. econ. Ent.* **34** no. 3 p. 468. Menasha, Wis., 1941.

Owing to the increased cost of tartar emetic (potassium antimony tartrate) and the possibility of a serious shortage of it in the future, a study of related antimony compounds that might be of value as substitutes for it in sprays against *Scirtothrips citri*, Moul., on *Citrus* has become of considerable importance. Extensive field experiments in California in 1940 showed that potassium antimony citrate gave fairly effective control of *S. citri*, but was less effective than tartar emetic even when used at twice the dosage. Since the pH of the tartar emetic spray solutions was in the region of 6.1, whereas that of spray solutions of potassium antimony citrate was in the region of 4.4, a laboratory study was undertaken to determine the effect of pH and the presence of various salts naturally occurring in spray waters on the toxicity of these materials; *Heliothrips haemorrhoidalis*, Bch., was used as the test insect. Oranges were dipped in solutions containing 1 per cent. sucrose, alone or with 1 per cent. tartar emetic or potassium antimony citrate, in distilled water, dried for 12 hours and infested with 50 adult thrips, the percentage mortality after seven days being used as a criterion of the effectiveness of the solution. The pH of the tartrate solutions was adjusted to values of 3-8 with sodium hydroxide or tartaric acid, and that of the citrate solutions with sodium hydroxide or citric acid. The toxicity of residues from solutions of tartar emetic and sucrose was significantly affected by the pH of the spray solution, those from solutions with pH values of 6 and 7 being the most toxic, and the effect of the pH on toxicity was much greater in the case of the citrate solutions, which were also most toxic at pH values of 6 and 7. At a pH of rather more than 7, a rapid decrease in effectiveness was noted, indicating a fairly narrow and critical pH range over which these two compounds lost almost their entire toxicity. The residues from solutions of potassium antimony citrate adjusted to a pH value of 6 were practically as toxic to *H. haemorrhoidalis* as those from a solution of tartar emetic at the unadjusted pH value in typical spray water (pH 6.1). The mortality on oranges dipped in solutions of sucrose only was very low and did not vary significantly with the pH.

YOTHERS (M. A.). ***Dyslobus tanneri* Van Dyke, a Pest of Apple in the Northwest.**—*J. econ. Ent.* **34** no. 3 pp. 469-470, 2 figs., 3 refs. Menasha, Wis., 1941.

In April 1916, all leaf and flower buds on certain apple trees in an orchard in Washington State were devoured by adults of a weevil, which were observed in large numbers feeding on the trees, and on dandelion and lucerne, in the evening and hiding under clods and

leaves during the day. Other apple trees of the same variety and prune trees were uninjured. Additional individuals were collected, not on fruit trees, in the same district in 1930, and the species was later identified as *Dyslobus tanneri*, Van Dyke, and stated to occur along the west coast of North America from British Columbia to northern California and in Idaho and Utah. Adults collected at the base of lucerne and dandelion plants in an orchard and in the litter at the base of mature apple trees in May and June 1940 and caged deposited eggs on the soil or on fragments of dead grass or weeds between 23rd May and 6th July; some of the eggs hatched on 8th June. Lists are given of the plants fed on and refused by the weevils in captivity. No males of this species have been observed.

FLANDERS (S. E.). **Dust as an inhibiting Factor in the Reproduction of Insects.**—*J. econ. Ent.* **34** no. 3 pp. 470–472, 18 refs. Menasha, Wis., 1941.

The author gives examples from the literature indicating that the presence of inert dusts on plants sometimes reduces the injury caused by insects. Dusts may form a mechanical barrier to the food supply, prevent the movement of legs and mouth-parts or clog the digestive system, and, at relative humidities below 70 per cent., they facilitate the desiccation of insects by modifying the permeability of the cuticle, exposing the permeable intersegmental membranes or increasing the evaporating surface of the body. The Homoptera and Hymenoptera represent the extremes in susceptibility to dusts, a difference due largely to differences in habit. The Homoptera can supply moisture, dissipated in the low humidity, by the constant intake of plant or animal juices and are well protected by a relatively thick chitinous body wall. The susceptibility of the Hymenoptera is correlated with specialised structures, the mechanism of which is discussed, for removing dust particles from their food or from the surface of their bodies.

Parasites may be more susceptible to dusts than their hosts and may be more uniformly affected, since most of them are Hymenoptera or Diptera and are consequently more uniform in structure and feeding habits. Folsom found that calcium arsenate dust had little, if any, lethal effect on the cotton aphid [*Aphis gossypii*, Glov.] or its predators, but destroyed its Hymenopterous parasites, and the same effect was obtained when inert dusts were applied to the plants [cf. *R.A.E.*, **A 16** 269]. The lethal effect on the parasites was determined by the amount of dust on the plants; as a rule, inert dusts, when used as carriers of volatile poisons, are not applied in amounts sufficient to affect insect parasites.

DOUCETTE (C. F.). **A Maggot attacking Carnation Shoots.**—*J. econ. Ent.* **34** no. 3 p. 472, 1 fig., 2 refs. Menasha, Wis., 1941.

Adults reared from larvae feeding on the developing shoots of carnations at Portland, Oregon, in the spring of 1936 were described by Hall as *Hylemyia abdena* [*R.A.E.*, **A 25** 563]. The injury was extensive in one locality, where it had been observed each year since 1933; except in two instances, it was found only on young plants growing out of doors. The plants are usually put outside in or after mid-April, when danger from frost is past. Injury due to this Anthomyiid first becomes noticeable early in May, and the larvae are full-grown in late May or early in June. Most of them pupate in the

soil below the plant, but occasionally a puparium is found in a plant tip. The adults emerge in the first half of June, but only a few larvae of the next generation were found in the carnation plants. After the cessation of feeding, most of the plants develop new growth, but many of them are deformed and have to be discarded. Nothing is known of alternative food-plants or of the method of overwintering of *H. abdena*. Records of species of *Hylemyia* on carnation in Europe are briefly discussed.

UTTER (L. G.). **Control of Tulip Aphids on Southern Iris.**—*J. econ. Ent.* **34** no. 3 p. 473. Menasha, Wis., 1941.

Heavy infestations of *Anuraphis tulipae*, Boy., appeared in New York on field-grown plants of *Iris* spp. and various hybrids that had been potted and placed in the greenhouse in October 1938. The Aphids occurred within the basal part of the leaf sheath and sometimes over the leaf surface, and later on the flower stalks and bracts. Infested leaves turned yellow and died, and plants with several infested shoots showed poor vigour; young and ripening seed pods were also injured. *A. tulipae* often occurs on iris in the field, but appears to cause negligible damage. Fumigation with Nicofume tobacco powder (containing not less than 14 per cent. nicotine) at dosages of 20 or 30 oz. per 1,000 cu. ft. for one hour gave poor control of the Aphid, and the higher dosage caused slight scorching of the plants. Cyanogas-G fumigant (containing not less than 42 per cent. calcium cyanide) gave excellent control of the Aphid and did not injure the plants at dosages of 2 or 3 oz. per 1,000 cu. ft. for one hour; this was confirmed by three fumigations of the entire greenhouse at intervals of approximately two weeks. Five fumigations were carried out at approximately biweekly intervals in 1939 and four in 1940, from October to January, with the lower dosage of Cyanogas, on about 350 pots of iris. Good control was obtained, but repeated treatments were necessary owing to the survival of individual Aphids within the leaf sheaths. Fumigation could not be continued later, as cereals, which were injured by Cyanogas, were grown in the same house, but biweekly spraying with a combination of 40 per cent. nicotine sulphate (1:400) and Grasselli Spreader Sticker (1:1,000) kept the plants fairly free from Aphid injury, though it did not penetrate so well into the leaf sheaths.

PYENSON (L.) & ROTH (R. W.). **Concentrations of Derris Sprays effective on the Imported Cabbage Worm.**—*J. econ. Ent.* **34** no. 3 pp. 473-474. Menasha, Wis., 1941.

In experiments carried out in New York towards the end of July 1940, insecticides were applied with knapsack sprayers or dusters in a field of cabbage heavily infested with larvae of *Pieris rapae*, L., most of which were half-grown. A spray containing 1 lb. derris (4 per cent. rotenone) per 100 U.S. gals. water with a spreader, applied thoroughly to the centre of the plants, where most of the larvae were feeding, gave 88-95 per cent. mortality and was as effective as the usual recommendation of 4 lb. derris per 100 U.S. gals. water with a spreader (87-92 per cent. mortality); it also compared favourably with derris dusts (0.75 per cent. rotenone) and pyrethrum (1 lb. Dry Pyroicide and 9 lb. talc), which gave 93-96 and 89 per cent. mortality, respectively.

No significant difference in kill resulted from the use of different spreaders, although technical mannitan monolaurate was the only one that gave good wetting of the leaves. This preparation is marketed as NNO, a combination of it with 1 per cent. rotenone [see also next abstract] as NNOR and combinations with 1.1 or 2.2 per cent. pyrethrins as NNOP 1.1 or 2.2 per cent. Tests with NNOR and NNOP indicated that they are less effective against *P. rapae* than the derris spray when they are used at dilutions of 1 : 600, 1 : 800 or 1 : 1,000 ; NNOR killed an appreciable number of eggs at a strength of 1 : 400. In field experiments with power sprayers on several farms on Long Island, however, NNOP 2.2 per cent. at a dilution of 1 : 600 was effective against larvae of *P. rapae* and cabbage loopers [*Plusia brassicae*, Ril.], if good spray coverage was obtained.

ROTH (R. W.) & PYENSON (L.). **Field Trials with two new Contact Insecticides.**—*J. econ. Ent.* **34** no. 3 p. 474, 1 ref. Menasha, Wis., 1941.,

In tests carried out in New York in the summer of 1940, sprays containing NNO (technical mannitan monolaurate), NNOR (96.4–97.2 per cent. NNO, 1 per cent. rotenone and 1.8–2.6 per cent. other derris extractives) and NNOP (NNO with 2.2 per cent. pyrethrins) gave 49, 89 and 80 per cent. mortality of *Aphis pomi*, DeG., on apple trees, when used at dilutions of 1 : 600, 1 : 1,000 and 1 : 1,000, respectively. Mortality in controls was 2–3 per cent. At 1 : 800, NNOR gave 92–94 per cent. mortality and was also very effective against Aphids on other plants. When NNOP at dilutions of 1 : 10, 1 : 25, 1 : 50 and 1 : 100 was injected into the tips of maize ears against *Heliothis armigera*, Hb., it gave results comparable with those obtained with mineral oil containing dichlorethyl ether or pyrethrins [*cf. R.A.E., A 29* 481 etc.] with less injury to the ears, though the infestations in the control plots were light and the results were variable. NNOR gave 86 per cent. mortality of potato flea-beetles [*Epitrix cucumeris*, Harr.] on egg-plant [*Solanum melongena*] at 1 : 1,200, and 97 per cent. mortality of thrips on young rhododendrons at 1 : 800. Applied to turf with a sprinkling can at the rate of 2 U.S. gals. per square yard, NNOR (1 : 800) gave 89 per cent. mortality of the hairy chinch bug [*Blissus hirtus*, Montd.], while derris (4 per cent. rotenone) at 2 lb. per 100 U.S. gals. water, with NNO (1 : 1,600), gave 92.5 per cent. mortality. No foliage injury was observed on any of the plants treated in these experiments.

BLANTON (F. S.). **Effect on Amaryllis Bulbs of hot Water and Cyanide used in Control of Bulb Fly Larvae.**—*J. econ. Ent.* **34** no. 3 p. 475. Menasha, Wis., 1941.

In preliminary tests on Long Island, New York, large and small bulbs of *Lycoris squamigera* were immersed in water at a temperature of 110°F. for one hour, excluding the time required for the centre of the bulb to reach this temperature (25 mins. for small bulbs and 85 for large ones), and other large bulbs were fumigated for 4 hours with hydrocyanic acid gas generated from sodium cyanide at a dosage of 7 oz. per 100 cu. ft., to kill the larvae of *Merodon equestris*, F. The large bulbs were very heavily infested before treatment, but the small ones were practically free from infestation. The bulbs were treated on 21st October 1938, 10 days after they were dug, and were planted in

the field 3 days later. They were screened to prevent reinfestation during the period of adult activity (10th May to 1st July on Long Island) in 1939 and 1940, and were dug in July 1940. When the bulbs were examined after harvest, none was found to be infested. The total weight of the small bulbs had increased, but some had apparently lain dormant during the entire two-year period, and others presumably rotted. The large bulbs lost weight, possibly because portions of the parent bulbs had been consumed by larvae of *M. equestris* or because they had divided into an average of 20 bulbs each, instead of the normal three or four. The increase in the number of bulbs may have been due to mechanical injury caused to the basal plate of the bulbs by the larvae, since this is sometimes injured with a knife in order to stimulate bulb production. It is possible, therefore, that *M. equestris* may be beneficial as a mechanical stimulant for increased production of bulbs, but it is not known whether the feeding of the larvae would offset this benefit.

BAKER (W. C.). **Type of Wood preferred by Coleoptera commonly found in decadent Parts of living Elm Trees.**—*J. econ. Ent.* **34** no. 3 pp. 475–476. Menasha, Wis., 1941.

In the control of the Dutch elm disease, caused by the fungus, *Ophiostoma (Ceratostomella) ulmi*, pruning dead and dying parts from living elm trees was carried out in Connecticut, New York, New Jersey and Pennsylvania during 1937–39, in order to reduce the numbers of active larvae of bark-beetles and other Coleoptera and eliminate material suitable for their development. To determine how much insect material could be removed by such work and what branches must be removed to make it most effective, numerous examinations were made throughout the year of limbs 1–14 inches in diameter pruned from a total of more than 600 elm trees. The size and condition of the branches in which various Coleoptera were found are discussed. *Scolytus multistriatus*, Marsh., and *Hylastes (Hylurgopinus) rufipes*, Eichh., both of which disseminate the fungus, were among the commoner species attacking dead and dying wood.

CAMPBELL (R. E.). **An unusual Infestation of Cabbage Aphids, *Aphis brassicae* L.**—*J. econ. Ent.* **34** no. 3 p. 477, 2 figs. Menasha, Wis., 1941.

Late in July 1940, the author's attention was drawn to an extremely heavy infestation by *Brevicoryne (Aphis) brassicae*, L., under the outer leaves of cabbages in California. Few Aphids were exposed on the outer leaves, and the plants were well grown and healthy in outward appearance. The owner of the field stated that the infestation had begun in the seedlings and, throughout its progress, had been confined to the inner parts of the plants. Four applications of nicotine dust were made during their growth, but they were delayed owing to wind, and the Aphids were able to develop. A spray failed to penetrate to the infested layers, and finally the infested leaves were stripped back and the cabbages were treated again. This eradicated the infestation, but the remaining cabbage heads were so small that the field was an almost total loss.

LINDGREN (D. L.) & SINCLAIR (W. B.). **The Ridging of *Citrus* Fruits as influenced by Fumigations of *Citrus* Trees with HCN.**—*J. econ. Ent.* **34** no. 3 p. 477. Menasha, Wis., 1941.

The ridges that are often observed on the surface of *Citrus* fruits have been found to be due to fumigation with hydrocyanic acid gas while the fruit is in the bud stage of development. Extensive counts made in 1940 showed 22–40 per cent. ridging of fruits from trees fumigated in February and only 0.1–0.2 per cent. on unfumigated trees and those treated in November or December.

FARRAR (M. D.), WINBURN (T. F.) & FLINT (W. P.). **How to know and control stored-grain Insects.**—*Circ. Univ. Ill. Coll. Agric. Ext. Serv.* no. 512, 16 pp., 18 figs. Urbana, Ill., 1941.

This circular on the insect pests that infest stored grain on farms in Illinois and their control replaces an earlier one [*R.A.E.*, A **28** 81]. In addition to very brief notes on the appearance, habits, life-history and importance of some 15 grain pests, most of which are illustrated, it contains instructions for preventing infestation and for control by fumigation [*loc. cit.*]. Though carbon bisulphide has been found a very effective fumigant, the best one is now considered to be a mixture of ethylene dichloride and carbon tetrachloride (3 : 1), which does not involve risk of fire. When exposed to the air at ordinary temperatures, this liquid mixture evaporates slowly and forms a heavy penetrating gas that sinks to the bottom of any container in which it is used. The liquid should be applied at the rate of 5, 6 or 8 U.S. gals. per 1,000 bushels grain in bins of 1,500–3,000, 500–1,500, or less than 500 bushels capacity, respectively. If the bin is not air-tight it should be made so, preferably by lining it with heavy building paper or sheet metal, although sometimes the open parts can be covered with heavy building paper from the outside. The surface of the grain must be at least 6 ins. below the top of the walls to prevent the gas from flowing over the edge, and must be levelled or the upper parts will not be adequately fumigated. If the surface layer has become solid, it should be broken up, and all sprouting and mouldy grain should be removed. The liquid is best applied by spraying it evenly over the surface of the grain with a force pump, which may be a bucket pump or garden sprayer. After application, a canvas or tarpaulin should be placed over the grain to reduce surface evaporation. Fumigation is most effective when the temperature of the grain is higher than 60°F., but in very hot weather, it should be carried out during the cooler parts of the day. To reduce reinfestation in shelled maize, an odourless white or unsaturated oil of viscosity 100–200 secs. (Saybolt 100°F.) should be added to the fumigant at the rate of 2–3 U.S. quarts per 1,000 bushels maize. Small quantities of seed can be fumigated in barrels, drums or glass jars, $\frac{1}{2}$ lb. liquid fumigant being used in a barrel of 50 U.S. gals. capacity; the exposure period should not exceed 72 hours if germinating power is to be unimpaired.

MCCULLOCH (L.) & WEIGEL (C. A.). **Gladiolus Diseases and Insects.**—*Fmrs' Bull. U. S. Dep. Agric.* no. 1860, 18 pp., 9 figs., 2 refs. Washington, D.C., 1941.

More than half of the section (pp. 10–18) on insect pests of *Gladiolus* in the United States deals with *Taeniothrips simplex*, Morison, which is

the most important, and particularly with its control in the stored corms [R.A.E., A **23** 757, etc.] and by spraying with a solution of 1 lb. tartar emetic and 2 lb. brown sugar in 50 U.S. gals. water [cf. **29** 204]. Other thrips that sometimes cause considerable damage to *Gladiolus* are *Frankliniella fusca*, Hinds, *F. tritici*, Fitch, *Hercinothrips femoralis*, Reut., and *Thrips tabaci*, Lind.

Pseudococcus maritimus, Ehrh., often infests the corms, particularly in fields previously under clover or weeds, and increases greatly on them after they are stored if the temperature is 60°F. or more. It occurs in clusters round the depressions at the base of the corms and root buds, causes the corms to shrivel, and may inhibit development or permit only weak and stunted growth. Control measures comprise fumigating the dormant corms with hydrocyanic acid gas from granular calcium cyanide at the rate of 2 oz. per 100 cu. ft. space for two hours at 60–70°F. or immersing them in water at a temperature of 116°F. for 30 minutes; higher temperatures or longer exposures may be injurious. *Anuraphis tulipae*, Boy., also infests the corms and damages them after they are stored; the foliage is rarely attacked by it. It is most frequently found on corms from sandy soil in fields that were previously under weeds or with weeds growing along the edges. *Myzus persicae*, Sulz., and *M. circumflexus*, Buckt., sometimes attack the young shoots of stored corms. Control measures include dusting infested corms with a 2 per cent. nicotine dust and covering them with cloth or burlap for several days, and the calcium cyanide or hot-water treatments used against *P. maritimus*. If Aphids appear on the leaves, buds or flowers, sprays of soap solution containing nicotine sulphate or pyrethrum extract should be applied. In greenhouses, frequent fumigation with calcium cyanide applied overnight at the rate of $\frac{1}{8}$ – $\frac{1}{4}$ oz. per 1,000 cu. ft. space or with nicotine smudges is recommended.

HEINZE (K.) & KÖHLER (E.). [Soybean Mosaic and its Insect Transmission.]—*Phytopath. Z.* **13** no. 3 pp. 207–242, 16 figs. 1940. (Abstr. in *Exp. Sta. Rec.* **84** no. 6 p. 775. Washington, D.C., 1941.)

The symptoms of soy-bean mosaic, including a strongly necrotic variant, are described. By the use of carborundum powder and juices from infected plants, 100 per cent. infection was obtained, and the virus was transmitted from soy bean to common bean and common vetch (*Vicia sativa*), but not to garden pea, hairy vetch (*V. villosa*) or *Pisum arvense*. It was also transmitted in experiments by the Aphids, *Aphis* (*Doralis*) *frangulae*, Koch [the species commonly known as *A. gossypii*, Glov.], *A. (D.) rhamni*, Boy., *A. (D.) fabae*, Scop., *Macrosiphum solanifolii*, Ashm., *M. solani*, Kalt. (*Aulacorthum pseudosolani*, Theo.), *Myzus ornatus*, Laing, *M. (Myzodes) persicae*, Sulz., and *M. (Neomyzus) circumflexus*, Buckt. No incubation period in the vector was necessary.

COX (J. A.). A preliminary Report on the Control of Comstock's Mealybug on Apple.—*Rep. Va hort. Soc.* **45** pp. 84–88. 1940. (Abstr. in *Exp. Sta. Rec.* **84** no. 6 p. 791. Washington, D.C., 1941.)

Satisfactory control of the first and second generations of Comstock's mealybug [*Pseudococcus comstocki*, Kuw.] on apple in Virginia was given in 1940 by two applications of a spray of 1 pint Loro, which

contains aliphatic thiocyanates [*cf. R.A.E.*, A **28** 615], in 100 gals. water against each generation, made when the mealybugs were in the first and second instars. Three applications of nicotine sulphate (1 : 400) were fairly effective against the young crawlers ; two applications of summer oil (1 : 100) did not give satisfactory control of crawlers of the second generation, but the oil showed promising results when combined with rotenone-bearing insecticides. It is concluded that in a heavily infested orchard there may be enough mealybugs left on the trees to cause considerable damage to the fruit at harvest, even though an insecticide has killed 90-95 per cent. of the first and second generations.

Cranberry Fruit Worm Control.—2 pp. multigraph. Ottawa, Publ. Ext. Div. Dep. Agric. Can., 1941.

The cranberry fruit worm [*Mineola vaccinii*, Riley] overwinters on the floor of the cranberry bog as a fully grown larva and pupates in spring. The eggs are laid in the calyx cups when the cranberries have nearly finished flowering, and the newly hatched larvae enter the berries, usually from the stem end, and feed on the contents. One larva may attack and destroy 3-5 berries. Infested berries turn red prematurely and may disappear by harvest time owing to the drying up and collapsing of the outer skin.

Keeping the bogs flooded in spring until May and flooding them again in autumn for 17 days immediately after harvest usually holds this Pyralid in check in New Brunswick. It has not caused extensive damage to low-lying bogs that are normally flooded each spring by freshet waters, but has sometimes attacked 50-60 per cent. of the berries in bogs that are not provided with facilities for flooding and in highland bogs where flooding is impossible, and in these circumstances control by insecticides is necessary. The applications should be made before the larvae enter the berries, and two are required to cover the whole period of hatching, the first when two-thirds of the petals have fallen, and the second 10 days later. In recent experiments with various insecticides in highland bogs in New Brunswick [*R.A.E.*, A **30** 112], synthetic cryolite dust, used undiluted or mixed with finely ground gypsum in dilutions of 50 or even 30 per cent. and applied at the rate of 30-40 lb. undiluted or 50-60 lb. diluted dust per acre, consistently gave the best control and did not injure the vines. Either hand-cranked or power dusting equipment can be used, but with the former, care should be taken to drive the dust into the vines as effectively as possible ; a canvas fastened to the boom of a power duster so that it trails 8-10 ft. over the cranberry vines may be used to advantage.

REMPEL (J. G.) & SHEVKENK (W.). **Notes on the Morphology, Life History, and economic Importance of *Smicronyx utilis* Buchanan. (Coleoptera, Curculionidae).**—*Canad. Ent.* **73** no. 6 pp. 100-104, 13 figs., 5 refs. Guelph, Ont., 1941.

Poverty weed (*Iva axillaris*), which occurs throughout Canada west of Manitoba and as far south as Mexico, is less prevalent than some other noxious weeds, but is one of the most difficult to eradicate. It is a perennial and usually grows on land that is low and rather alkaline, but it is also often found in pastures and cultivated fields on high and

well-drained soil. It is most prevalent in Saskatchewan, but owing to the fact that high percentages of the seeds in this Province are infested by *Smicronyx utilis*, Buchanan [*R.A.E.*, A 29 530], which was first observed in 1936, and many of the others are not viable, it appears to spread by rootstocks only. This facilitates eradication considerably. The percentages of seeds infested in 4 localities in Saskatchewan in 1937 and 14 in 1940 ranged from 0 to 100.

The immature stages of the weevil and the morphology of the larva are described. The adults appear in the first week of June, when the food-plant begins to flower, and feed for some days, chiefly on the flowering parts. Mating takes place about 10th June, and oviposition begins ten days later. The eggs are deposited in the young ovaries, near the style, through a hole gnawed through the bract of the involucre and the ovary wall; only one egg is laid in each ovary. The larva hatches in 7-10 days, feeds on the cotyledons, and eventually completely consumes the embryo. When full-fed, it leaves the ovary through a hole near the base and enters the soil. The larvae are leaving the seeds from mid-July to mid-August. They overwinter in the soil, rarely deeper than 2 ins., and pupate about the end of the following May.

The authors consider that the introduction of this weevil into areas where it is not present would be feasible and possibly of considerable economic importance.

BROOKS (R. L.), ADAMSON (A. M.), BAKER (R. E. D.) & CROWDY (S. H.).
Durability Tests on untreated Timbers in Trinidad.—*Caribb. Forester* 2 no. 3 pp. 101-119, 1 ref. Rio Piedras, P.R., 1941.
 (With a Summary in Spanish.)

An account is given of tests carried out in Trinidad in the three years 1937-40 on the susceptibility of seasoned untreated timber from trees of 33 species to attack by fungi and termites. Test pieces 3 ft. long were inserted in the ground to a depth of 1 ft., termite-infested pieces of wood collected in the vicinity being placed between some of the rows, and were examined every six months. They were attacked in all by ten species of soil-dwelling termites; *Heterotermes tenuis*, Hag., was the most abundant and destructive, *Coptotermes testaceus*, L., was somewhat less prevalent, and *Eutermes (Nasutitermes) costalis*, Hlmgr., was fairly abundant. The other species were present in negligible numbers. None of the timbers proved immune from termite attack, but the five most resistant were not seriously attacked until the third year. A list of the timbers tested, together with the percentages attacked and destroyed by termites, is included. Fungi caused more damage than the termites, but there was a close correlation between the relative susceptibility of some of the timbers to both. The comparative resistance to both forms of attack is summarised in a table.

WOLCOTT (G. N.). **The Dispersion of the Cottony Cushion Scale in Puerto Rico in eight Years.**—*Caribb. Forester* 2 no. 3 pp. 132-135, 1 map. Rio Piedras, P.R., 1941. (With a Summary in Spanish.)

Details are given of the spread of *Icerya purchasi*, Mask., in Porto Rico since it was first recorded there [*cf. R.A.E.*, A 20 697] and its

distribution in 1938 is shown on a map. It attacks *Citrus*, but is chiefly a pest of the Australian pine, *Casuarina equisetifolia*. Its spread from the original focus in the north-east has been chiefly in a westerly direction along the north coast, following the prevailing winds [cf. 22 152], and it has reached the western end of the island. It occurs elsewhere in scattered foci thought to be due to the dispersion of infested stock. Periodic liberations of *Rodolia* [*cardinalis*, Muls.] have been made [26 223; 27 434], and this Coccinellid now appears to be effectively established. The Coccid has been spread on *Casuarina* seedlings from Porto Rico to Mona Island and the Dominican Republic [cf. 29 498].

FORS (A. J.). **Informe sobre plantaciones forestales en Cuba.**—*Caribb. Forester* 2 no. 3 pp. 138–140. Rio Piedras, P.R., 1941. (With a Summary in English.)

In this note on factors affecting the successful development of plantations of timber trees in Cuba, it is pointed out that the extensive planting of Spanish cedar [*Cedrela*] in unmixed stands favours infestation by the shoot borer, *Hypsipyla grandella*, Zell. Some of the young plantations have been entirely destroyed by this Pyralid.

MARTORELL (L. F.). **Biological Notes on the Sea-grape Sawfly, *Schizocera krugii* Cresson, in Puerto Rico.**—*Caribb. Forester* 2 no. 3 pp. 141–144, 4 figs., 3 refs. Rio Piedras, P.R., 1941. (With a Summary in Spanish.)

Descriptions are given of all stages of *Sterictiphora* (*Schizocera*) *krugii*, Cress., of which *Sterictiphora zaddachi*, Dewitz [cf. *R.A.E.*, A 6 391; 28 524] is a synonym. This sawfly severely defoliates trees of the genus *Coccoloba* in Porto Rico, particularly during the winter and spring. The males are gregarious and can often be seen in groups of 10–20 on the lower surface of the leaves, but are less numerous than the females. Pairing and oviposition take place on sheltered parts of the tree. The eggs are laid in batches of 15–40 on the lower surface of the leaves; a female takes several hours to deposit a cluster and then remains over it for a considerable time. The larvae are gregarious and feed on the edges of the leaves; pupation occurs on the twigs, branches or trunks, and the pupal stage lasts about 20 days. *S. krugii* occurs from sea-level to altitudes of 2,700 ft. Its preferred food-plant is *Coccoloba uvifera*, which grows on the coast, but it has also been recorded on *C. grandifolia*, *C. laurifolia*, *C. venosa*, *C. pirifolia* and *Chrysobalanus icaco*. No natural enemies have been recorded. The larvae can be controlled by a spray of 3 lb. lead arsenate in 100 U.S. gals. water, with soap as an adhesive.

PEMBERTON (C. E.). **Entomology.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1939–40* pp. 17–21. Honolulu, 1941.

No new insect pests of sugar-cane appeared in Hawaii during the year ending September 1940, and there was little change in the status of those already known. *Anomala orientalis*, Waterh., had slightly extended its distribution on Oahu, but caused no visible damage to cane, and its Scoliid parasites, *Campsomeris marginella modesta*, Sm., and *Tiphia segregata*, Crwf., continued to be prevalent. Damage by

Rhabdocnemis obscura, Boisd., was light on most plantations, but damage to one variety of cane was reported in ratoon fields at a locality on the island of Hawaii where unusually heavy winds during January broke and cracked much well-grown cane, thereby enabling the borer to develop in places inaccessible to the parasite, *Ceromasia* (*Microceromasia*) *sphenophori*, Villen., which continued to operate successfully over most of the Territory during the year. During April 1940, the author found *Dactylosternum hydrophiloides*, MacL., established at Honokaa, on the north coast of Hawaii. This Hydrophilid, the larva of which is predacious on the larvae of *R. obscura* and which was introduced from the Philippines and liberated at Honokaa in 1925, had not been seen since it was released; it is not sufficiently numerous to afford much control.

Laphygma exempta, Wlk., was again abundant during the first five months of the year on a number of cane plantations, but there were no outbreaks on Oahu and those on the other islands were not so extensive or prolonged as in the previous year [*R.A.E.*, A 28 461]. Further liberations of *Telenomus nawai*, Ashm., were made, and it is believed that this Scelionid contributed largely to the control of *Laphygma* during the year. Other parasites, particularly *Euplectrus platyhypenae*, How., were of importance at times. *Nacoleia* (*Omiodes*) *accepta*, Btlr., has practically disappeared from the plantations on Oahu where it was conspicuous during 1939. The Delphacid, *Perkinsiella saccharicida*, Kirk., was abundant in one field of POJ 2878 during May and June, but was accompanied by large numbers of *Cyrtorhinus mundulus*, Bredd., which is predacious on its eggs. During September 1940, *Iridomyrmex humilis*, Mayr, was found in large numbers in the Fort Shafter region of Honolulu. This is the first time that this ant has become definitely established in the Hawaiian Islands.

All trans-Pacific aircraft arriving at Pearl Harbour during the year from the Orient or New Zealand were inspected for insects and treated with insecticide at either Midway or Canton Islands [*cf.* 30 99], and no serious insect pests have reached Hawaii alive in them. Aircraft of the Pan American Airways bound for Hawaii also stop at New Caledonia, and a survey of insect pests of sugar-cane and other economic plants on the Island was therefore being carried out by F. X. Williams. Preliminary reports indicate that several insects occur on sugar-cane there that are not known in Hawaii [see next abstract].

MARTIN (J. P.). **Pathology.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1939-40* pp. 22-39. Honolulu, 1941.

It is stated in the course of this report that one of the insects found by Williams on sugar-cane in New Caledonia [see preceding abstract] was a species of *Perkinsiella* and that he also demonstrated the presence of Fiji disease of sugar-cane, of which this Delphacid is a vector, on that Island.

CELINO (M. S.) & OCFEMIA (G. O.). **Two additional Insect Vectors of Mosaic of Abacá, or Manila Hemp Plant, and Transmission of its Virus to Corn.**—*Philipp. Agric.* 30 no. 1 pp. 70-78, 1 pl., 16 refs. Los Baños, P.I., 1941.

Since mosaic of Manila hemp (*Musa textilis*) has been shown to be transmitted by more than one species of Aphid in the Philippines, and

the virus that causes it is closely allied to or identical with *Marmor cucumeris* of Holmes [cf. *R.A.E.*, A **29** 316, 317], a search was made for other vectors. In August 1940, *Aphis maidis*, Fitch, was numerous on seedlings of *Musa textilis* growing a few yards from maize at an experiment station. In tests later in the year, this Aphid transmitted the virus from diseased to healthy *M. textilis*, from *M. textilis* to maize, and from maize to maize and *M. textilis*. The virus was not transmitted through the seed of maize, and it is considered that, as *A. maidis* rarely feeds on *M. textilis* in nature, the virus is seldom transmitted to maize in the field. During the summer of 1940, several plants of *M. textilis* from a locality in which the disease had not been observed were found to be infected with mosaic. No Aphids were present on them or on the surrounding plants, but colonies of a species of *Rhopalosiphum*, near *prunifoliae*, Fitch, were found on *Paspalum conjugatum*, *Cynodon dactylon* and other grasses nearby. In subsequent experiments this species transmitted the virus from diseased to healthy *M. textilis*. No transmission was obtained in further experiments with *Pentalonia nigroervosa*, Coq. [cf. **29** 317] or in experiments with *Aphis laburni*, Kalt.

MAYER (A.). **Ernährungsphysiologische Untersuchungen an Nonnenraupen** (*Lymantria monacha* L.). [Investigations on the Physiology of Nutrition of Larvae of the Nun Moth, *L. monacha*.]—*Z. angew. Ent.* **27** pts. 2-3 pp. 157-207, 408-449, 17 figs., 2 pp. refs. Berlin, 1940. [Recd. 1942.]

An account is given of detailed investigations in the laboratory in 1936-37 supplemented by observations in a forest near Berlin in 1937 on the effect on the development of larvae of *Lymantria monacha*, L., and on the fertility of the resultant adults, of feeding on the foliage of various trees [cf. *R.A.E.*, A **23** 742]. The temperatures at which the larvae were kept ranged from 11 to 31°C. [51·8-87·8°F.].

The following is based on the author's summary. Development to the fourth instar was quickest on beech, followed by oak, *Carpinus*, larch, birch, pine and spruce. The leaves of beech, however, harden quickly, and when this mechanical factor operates, the larvae migrate to other food. These observations were confirmed in the forest. Seedlings of pine and, especially, spruce were in general unfavourable, though the physiologically stronger larvae developed well on the former. In addition to the chief food-plants, 69 other plants were tested; a list of these is given showing those that enabled all or nearly all the larvae to develop normally, those that permitted delayed development, those on which only the strongest larvae developed and those on which no development was possible.

The differences in nutritive value were accentuated by interposing periods of starvation, and if feeding was interrupted during the final instar, pupation was delayed. An unaltered diet was more advantageous than a change of food, unless it was a change to a more favourable one, and when the food was changed, the effect of the later food outweighed that of the earlier one. The number of moults varied inversely with the suitability of the food and increased for a given food as the temperature differed from the optimum. On an average, the number of eggs laid by individual females decreased as the unsuitability of the food increased, and the differences between the foods were accentuated by harmful high temperatures. The maximum number

of eggs matured was 447, in the case of a female bred on birch at 22°C. [71·6°F.], and the maximum number of fertilised eggs deposited was 434, in another female of the same batch. The percentage of females in a population decreased with unsuitable food, and, with a given food, it increased at harmful high temperatures.

The food of the older larvae is the most important as regards reproduction. Egg-production is decreased by hunger in the final larval instar, and would be adversely affected if feeding in that stage were restricted to conifers because of defoliation of the favourable deciduous plants. Defoliation of all the chief deciduous food-plants before the final larval instar is reached must result in the collapse of an outbreak.

GOETSCH (W.). **Beiträge zur Bekämpfung von Ameisen-Staaten.**

I. Teil. [Contributions to the Control of Ant Colonies.]—*Z. angew. Ent.* **27** pt. 2 pp. 273–320, 4 figs., 3 graphs, 14 refs. Berlin, 1940. [Recd. 1942.]

The author gives some examples of the frequently observed rejection by ants of sweetened poison baits, and records in detail the results of many series of laboratory experiments with ants of German, Italian and Argentine origin in artificial nests, and of field tests in a botanical garden in Saxony. The baits used were two proprietary sweetened poisons (one stated to contain arsenic), modifications of these, and baits of protein (meat, fish, bone meal, or larvae of *Tenebrio molitor*, L.) mixed with various poisons. The results showed that ants that had fed on sugar almost always refused sweetened baits, but that these were readily accepted after protein foods. They were attractive for only a short time, however, and were then neglected. Sweetened baits were never accepted after the ants had tended Aphids. A bait is usually not distributed equally throughout a nest, since only certain groups of ants feed on it. The occurrence and reassembly after dispersal of such groups was proved by using coloured baits; thus, it is only a given group that is surfeited and refuses the bait. Sugarless poison baits were much more effective than the two proprietary baits tested, and the addition of a protein bait to one of the latter increased its effectiveness. Where baits and poison occasionally fail against a species or individuals, the nest should be fumigated; an instance of such fumigation with a proprietary preparation is described.

FRANZ (J.). **Der Tannentriebwickler *Cacoecia murinana* Hb. Beiträge zur Bionomie und Oekologie.** [Contributions to the Bionomics and Ecology of the Silver-fir Shoot Tortricid, *Tortrix murinana*.]—*Z. angew. Ent.* **27** pt. 3 pp. 345–407, 19 figs., 14 diagrs., 2 pp. refs. Berlin, 1940. [Recd. 1942.]

This thesis comprises a detailed account of investigations in a forest district in Baden on the bionomics and ecology of *Tortrix* (*Cacoecia*) *murinana*, Hb., on silver fir (*Abies alba*). The forest was one of 100-year-old silver firs with approximately 25 per cent. of oaks, and the other silver-fir shoot Tortricid, *Enarmonia* (*Semasia*) *rufimitrana*, H.-S., was present in very small numbers. The observations were made by means of platforms erected in the trees.

T. murinana has one generation a year. The eggs are laid in June and July on the needles of old firs, and the larvae hatch in about 10 days and seek shelters in the crowns of the trees, apparently without

feeding. They then moult once and spin webs, in which they hibernate until April or May. On resuming activity, they mine the buds and develop between the needles of the growing shoots, which they web together, until they reach the sixth and final instar. Pupation occurs in June, between needles spun together or on the trunk or in the ground.

The overwintered larvae appear on the branch tips when the leaf buds are bursting. They are unable to enter the buds until the lignified scales have parted, and do not attempt to bore into dormant buds. The flower-buds, which open before the leaf-buds, supply food for early larvae and are heavily infested; the destruction of the female flowers may cause a serious loss of seed. The larvae spread on the tree crown and to neighbouring trees by crawling and by allowing themselves to be borne by the wind on threads. These second-instar larvae cease to crawl at about 4°C. [39·2°F.] and are unable to bore into the buds at temperatures below 9°C. [48·2°F.]. The older larvae feed by day and by night, and each individual destroys about 120 needles. The leaf-buds at the summit of the tree, which develop late, escape attack by the young larvae, but are heavily fed upon by fourth-instar and older ones. The females, which represented 58 per cent. of the population, produced for about ten days after emergence a scent that is attractive to the males. The adults fly chiefly towards midnight, and the largest numbers occur in the upper parts of the tree crown. In the laboratory at about 20°C. [68°F.] adult life averaged 10–13 days. The average number of eggs deposited per female was about 100. The development of the egg is described in some detail.

In a brief discussion of alternate food-plants [cf. *R.A.E.*, A 24 341], it is stated that the larvae were also observed on *Abies grandis* in the district in which the investigations were made.

MEUCHE (A.). **Untersuchungen am Rapserrdfloh** (*Psylliodes chrysocephala* L.) **in Ostholstein.** [Investigations on the Rape Flea-beetle, *P. chrysocephala*, in East Holstein.]—*Z. angew. Ent.* **27** pt: 3 pp. 464–495, 13 figs. Berlin, 1940. [Recd. 1942.]

Observations on *Psylliodes chrysocephala*, L., infesting two varieties of oil-producing rape were made in East Holstein in August–December 1939 and March 1940. The outbreak of this flea-beetle was terminated in the intervening period by the extremely cold weather, with a minimum temperature of –32·5°C. [–26·5°F.] in February.

The first period of feeding by adults was over by August and many of the beetles were aestivating in the stems. An examination in a field that had been harvested in July showed 805 young adults in 500 stalks, or an estimated population of 8·8 million for a 25 acre field. In neighbouring parkland the beetles were abundant in the undergrowth. The seedlings in two fields of rape planted early in August developed normally after fairly heavy attack, but a field of rape drilled on 11th August suffered severely, for the flea-beetles fed on the leaves and stems of the seedlings, and, owing to the dry weather, the plants were unable to recover from the injury. The larval population in individual rape plants was greatest in large vigorous ones. In a weedy rape field examined in September, field mustard (*Sinapis arvensis*) was the most heavily infested plant, while *Capsella bursa-pastoris* and *Thlaspi arvense* were only slightly infested. In December, the mustard plants

were dying and infested by only a few larvae, but the infestation had increased on rape.

Variations in the seasonal infestation of varieties of rape by the larvae in different parts of Germany are recorded and discussed. The date of planting influences oviposition, since the females feed before laying their eggs, and also affects the duration of the exposure of the eggs and larvae to winter cold and the consequent speed of development. Weather influences the maturation of the females, which in turn affects the date and duration of oviposition; a mild winter prolongs the optimum period for oviposition. Whether a change in the date of planting can materially influence the date of occurrence of *P. chryscephala* requires further investigation.

The only natural enemies of any importance were the Ichneumonid, *Temelucha carinifera*, Thoms., and the Braconid, *Diospilus capito*, Nees, which were bred from the larvae in East Holstein and near Bonn, respectively. In experiments with various proprietary dusts against the adults, the most effective proved to be a derris preparation, followed by a mixture of pyrethrum and derris. Deep ploughing in October destroyed the eggs and larvae.

BERAN (F.). **Versuche zur San-José-Schildlaus-Bekämpfung mit Blausäure.** [Experiments with Hydrocyanic Acid Gas against the San José Scale.]—*Z. angew. Ent.* **27** pt. 3 pp. 496-502, 5 refs. Berlin, 1940. [Recd. 1942.]

The experiments described were made to ascertain the dosages and exposures required to control *Aspidiotus perniciosus*, Comst., by means of fumigation with hydrocyanic acid gas under the conditions obtaining in practice in Austria. Calcium cyanide was used in the form of Calcid briquettes, which generate an amount of hydrocyanic acid gas equal to half their weight. It was also sought to ascertain whether the dosage prescribed against *Phylloxera [vitifoliae]*, Fitch] on grape vines (5 oz. Calcid per 1,000 cu. ft. for 4 hours) would suffice against the Coccid, as this would permit the framing of uniform regulations. Currant bushes infested by *A. perniciosus* were covered by air-tight plywood boxes each of about 35 cu. ft. capacity; the required amount of Calcid was blown into the chamber, and the opening sealed with special paper. The temperature during the tests averaged about 15°C. [59°F.], and the relative humidity was over 90 per cent. The results, which are shown in a table, were somewhat variable, and the percentage mortality in the controls ranged from nearly 40 to over 79. Dosages of 5 and 10 oz. Calcid per 1,000 cu. ft. did not give complete mortality in every case, even after 4 hours, and one of 20 oz. was occasionally unreliable after 1 hour, but 100 per cent. was obtained with 20 oz. in 2 hours, 30 oz. in 1 hour and 60 oz. in 30 minutes. In further tests, however, a 20-oz. dosage was effective in 1 hour, and it is considered that this dosage is sufficient if an airtight fumigation chamber is used.

THOMAS (I.) & JACOB (F. H.). **British Aphididae. 1. The Genus *Pentatrichopus* Börner (Hemiptera).**—*Proc. R. ent. Soc. Lond.* (B) **10** pts. 6-7 pp. 107-123, 9 figs., 11 refs. London, 1941.

The authors briefly discuss the scope of the genus *Capitophorus*, in which some workers include most of the Aphids with capitate hairs,

and the status of some of the other genera, including *Pentatrichopus*, that they consider distinct from it. They give a list of species included in *Pentatrichopus* by Börner, and a key to the apterous and alate viviparae of the three British species [cf. *R.A.E.*, A 29 27], followed by descriptions of their various forms, notes on their food-plants [29 28], and a further discussion of the synonymy of *C. (P.) fragariae*, Theo. [29 27]. Material from North America examined by them included apterous viviparae indistinguishable from *fragariae*, taken on *Potentilla* sp. and *Fragaria* sp., apterous and alate viviparae taken on strawberries, *Potentilla monspeliensis* and roses and thought to be distinct (on the basis of characters shown in a table) from either *fragariae* or *C. (P.) potentillae*, Wlk., and oviparae and alate males from *Potentilla* that may be the sexuales of the latter species. If there are, in fact, two American species, it is uncertain to which the name *C. (P.) fragaefolii*, Kll., should be applied and consequently whether or not *fragariae* is a synonym of it. It is unlikely that *fragaefolii* can be a synonym of *potentillae*, since, in the authors' investigations, the latter did not attack any plant other than *Potentilla anserina* [29 28], on which it occurred throughout the year in North Wales.

NIXON (G. E. J.). **New Braconid Parasites of *Antestia lineaticollis*, Stål, and of *Sylepta derogata*, F.**—*Bull. ent. Res.* 32 pt. 2 pp. 93–101, 19 figs., 3 refs. London, 1941.

A brief revision is given of the African Braconids of the genus *Aridelus* (*Helorimorpha*), and one new species, *A. taylori*, is described from females bred from a species of *Antestia*, presumed to be *A. lineaticollis*, Stål, in Uganda. Other members of the genus that parasitise *A. lineaticollis* are *Aridelus* (*H.*) *coffae*, Brues, which occurs in Kenya and Uganda [*R.A.E.*, A 23 278; 29 230] and *A. (H.) rufus*, Cam., which is the species previously recorded from Tanganyika as *Helorimorpha* sp. [26 179]. A key is given to the females of these three species and *A. africanus*, Brues, and the characters common to them are described. The original descriptions of the other three African species of *Aridelus*, which are not known to the author, are quoted; one of them is *A. luteus*, Szép., with which *A. coffae* is considered to be probably identical.

Benama hutsoni, gen. et sp. n., is described from adults of both sexes bred from a larva of *Sylepta derogata*, F., in Ceylon, and characters distinguishing the genus from *Diospilus* are given.

KIRKPATRICK (T. W.). ***Helopeltis* (Hem., Capsidae) on *Cinchona*.**—*Bull. ent. Res.* 32 pt. 2 pp. 103–110, 3 figs., 9 refs. London, 1941.

Observations were made during 1940 on the bionomics of *Helopeltis bergrothi*, Reut., on *Cinchona* at Amani, Tanganyika Territory, where two distinct varieties of this Capsid, *rubrinervis*, Popp., and *disciger*, Popp., occur in apparently equal numbers. Characters distinguishing the adults are given, together with the results of breeding experiments showing that *disciger* is a simple Mendelian recessive to *rubrinervis*. Both varieties were found only on *Cinchona* at Amani in 1940, but each was recorded there on *Ricinus* and *disciger* on *Bixa* in 1911, and the author has received specimens of both from cotton in eastern Tanganyika. The offspring of adults from *Cinchona* fed on *Bixa*, cotton and tea and produced typical lesions, but none survived for

more than a few days. Some varieties of *Cinchona* appeared to be more extensively attacked than others, but the difference may be due rather to differences in the age of the plants, young ones being apparently preferred. The number of lesions produced by a single third-instar nymph in one day ranged from 60 to 140 and averaged 85; in one plot in which injury was severe, the average population was thought not to exceed one adult and one or at most two nymphs per tree.

The eggs are deposited deep in the tissue of the younger branches, or in the petiole or the mid-rib within an inch of the base of the leaf. In the laboratory, the egg stage lasted 16 days in April, when the average temperature was 23°C. [73.4°F.], and 23 in June, when it was about 21°C. [69.8°F.], but it is probably shorter during the warmer weather from January to March. Only slightly more than half the eggs hatched, mostly during the afternoon. The nymphal stage lasted 22–27 days in April and May and 30–35 in June and July. The adults did not pair until nine days after they had emerged, and the period from emergence to oviposition lasted about 12 days. The number of eggs laid per day is variable; the total number laid by single females of *rubrinervis* and *disciger* averaged 169 and 202, respectively, and the oviposition periods averaged 75 and 78 days. It is probable that fewer eggs hatch or are deposited under field conditions. Unfertilised females deposited a normal number of eggs, but none hatched. Populations on *Cinchona* were lower in June and July than during January–April, but there was some increase during August and September.

A Braconid, probably of the genus *Euphorus*, attacks nymphs in any instar but the first, and there is some evidence that the presence of this parasite retards the development of the host. The full-grown parasite larva leaves its host during the night, 16–21 days after the deposition of the egg, and if soil is available, enters it for pupation. If it has not spun a cocoon by about 8 a.m., it generally fails to spin one and dies a few days later. The adults emerge 20–23 days after the formation of the cocoon, and the females may oviposit on the same day. Unfertilised females produce only male offspring. Adults fed on sugar solution survived for 11 days. Nymphs parasitised in the second and third instars die 1–8 days later without becoming adult, but most of those parasitised in the fifth and probably also in the fourth instar complete their development and are capable of breeding normally.

An Ichneumonid, tentatively determined as *Stictopisthus* sp., also attacks the nymphs, but is almost certainly hyperparasitic. Fourth- and fifth-instar nymphs that were not parasitised by *Euphorus* were attacked by females of *Stictopisthus*, but no eggs were found in two that were dissected, and the remaining 24 developed and bred normally; the author considers that the females of *Stictopisthus* are unable to recognise the presence of a larva of *Euphorus* except by trial in this way, but it is not certain that the female parasites used in this experiment were fertilised, and it is possible that unfertilised females may be incapable of oviposition, although they sting readily.

In small-scale cage experiments, a bait-spray of a solution of 5 lb. sugar in 4 gals. water to which sodium arsenite was added at the rate of $\frac{1}{2}$, 1 or 2 oz. was effective, but the sodium arsenite at the lowest rate lost its effectiveness after a single night's dewfall, and at the highest rate caused some injury to the leaves. Two very light

applications at an interval of about three weeks during dry weather would probably give satisfactory results. A similar sweetened spray containing 0.4 per cent. by weight of sodium fluoride was ineffective.

NIXON (G. E. J.). **New African and Oriental Species of *Microdus*, Nees, from known Hosts (Hymenoptera, Braconidae).**—*Bull. ent. Res.* **32** pt. 2 pp. 111–118, 10 figs., 1 ref. London, 1941.

The new species are *Microdus fabiae*, reared from *Earias fabia*, Stoll, and *M. glyphodis*, from *Margaronia coeruleiceps*, Hmps., both in Malaya; *Microdus leucotretae*, from *Argyroprocte leucotreta*, Meyr., on *Pseudolachnostylis maprouneaeifolia* in Southern Rhodesia; and *M. bishopi*, from the same host on *Citrus* in Cape Province. The first two species are described from single females and the others from adults of both sexes. *M. bishopi* is compared with two closely allied species of *Microdus*, and a list of 15 African and Oriental species of the genus that are not known to the author is appended.

GOLDING (F. D.). **Two new Methods of trapping the Cacao Moth (*Ephestia cautella*).**—*Bull. ent. Res.* **32** pt. 2 pp. 123–132, 3 refs. London, 1941.

Ephestia cautella, Wlk., which attacks stored cacao in West Africa but causes serious damage only where cacao is stored locally for long periods, has become numerous in Nigerian stores as a result of war-time conditions. An account is given of experiments on two new methods of trapping the adults; they are to be regarded as supplementary to the routine measures recommended, which include maintaining scrupulous cleanliness, stacking the bags on scantling with an alley-way between them and the walls of the storehouse, and brushing the outside bags to destroy larvae and pupae.

The first method consists of treating broom strands (the mid-ribs of leaflets of *Elaeis guineënsis* or *Raphia sudanica*) with an adhesive and suspending them at about one-foot intervals from twine tied horizontally, about 10 ft. from the ground, along the alleyways between the stacked bags. Experiments showed that the most effective adhesive for general use was one prepared by heating together 3 parts até (the latex of a vine, probably *Carpodinus* sp.) coagulated with lime juice and 1 part shea butter (obtained from *Butyrospermum parkii*) or palm oil. It should not be applied to the strands until it is cool; 500 strands are required in a store 100 ft. long and 25 ft. wide. Catches of 60–80 moths per strand have been frequent, and the moths have been almost completely eradicated in two or three nights from heavily infested stores in which this method of trapping has been used. They are thought to be attracted to the strands because these provide a suitable resting place, and not by the odour of the adhesive.

The second method was the use of trap dishes containing a solution of carbolic soap, which was considerably more effective than the standard material used in Nigeria, which is obtained from the roots of cassava [*Manihot* sp.], and other substances previously recommended [*R.A.E.*, A **18** 427; **22** 619]. Other soaps and an emulsion of soap jelly and kerosene gave comparable results, but the trap dishes were not so effective or cheap as the broom strands, and work on them was discontinued.

In addition to cacao, larvae of *E. cautella* attack stored ground-nuts and, occasionally, maize. The infestation of ground-nuts by *Ephestia* is discussed; in the author's opinion it could be considerably restricted by reducing the length of the export season from 12 to 7 months.

In early February 1940, some stores were temporarily infested by adults of *Ahasverus advena*, Waltl, which, however, did not appear to attack the cacao; when placed in jars containing cacao beans, they died without feeding or breeding. A few adults of *Araecerus fasciculatus*, DeG., were also present, but had not increased in numbers by early June. Considerable damage was done between October and May by *Lasioderma serricorne*, F., in a store in which the moisture content of the beans was found to be 5.7–5.8 per cent., and in several others in two districts. Fly-papers placed in light situations and with the tops less than 8 feet above the floor were effective against them; two such papers smeared with an adhesive prepared by heating together 3 parts resin and 1 part shea butter trapped 658 beetles in a fortnight.

Details of the various adhesives tested in experiments with fly-papers and with broom strands are given in an appendix.

HINTON (H. E.) & STEPHENS (F. L.). **Notes on the Biology and immature Stages of *Cryptophagus acutangulus*, Gyll. (Col., Cryptophagidae).**—*Bull. ent. Res.* **32** pt. 2 pp. 135–143, 10 figs., 12 refs. London, 1941.

The feeding habits and bionomics of *Cryptophagus acutangulus*, Gyll., were investigated in an attempt to obtain further information on the feeding habits of species of this genus, 19 of which have been recorded from houses, cellars, warehouses, mills and granaries. They are believed to feed on fungi, but little is known of their ability to transmit fungi to uninfected stored food or other materials. All stages of *C. acutangulus* and its life-history are described. The adults fed readily on twelve species of fungi representing seven Orders and thrive when fed exclusively on conidia of *Penicillium*; they only rarely ingested other types of food. The larvae were fed entirely on the spores and hyphae of fungi.

Experiments showed that conidia can be transmitted mechanically from the surface of the legs and bodies of the beetles, and by the faeces. Of *Penicillium* conidia that had passed through the alimentary canal, approximately 15 per cent. germinated, and the period elapsing before germination was reduced from 5–8 to 1–2 days, probably owing to the partial digestion or fermentation of the walls of the conidia.

BRYANT (G. E.). **On the African Species of *Phyllotreta* (Col., Halticinae).**—*Bull. ent. Res.* **32** pt. 2 pp. 145–152, 3 figs. London, 1941.

This paper contains a list of the 28 African species of *Phyllotreta* and a key to 26 of them. Six are described as new, and references to the original descriptions of the others are given, with the countries from which they were described. One of the new species is *P. cadabae*, which was taken in the Anglo-Egyptian Sudan and is reported to feed on *Cadaba rotundifolia*. Other species of potential economic importance are *P. capicola*, Bryant, on cabbage, *P. cheiranthi*, Weise, on cotton, cabbage and wallflower, *P. hargreavesi*, Bryant, on *Gynandropsis* sp., *P. flavifrons*, Jac., on *Hibiscus esculentus*, *P. tenuimarginata*, Jac., on cotton and *Acacia mellifera*, and *P. mashonana*, Jac., on turnips and radish.

VESEY-FITZGERALD (D.). **Some Insects of economic Importance in Seychelles.**—*Bull. ent. Res.* **32** pt. 2 pp. 153–160. London, 1941.

The author gives an annotated list of over 50 species of insects that are minor pests or that are parasitic or predacious on pests in the Seychelles. The most important pest of coconut dealt with is *Oryctes monoceros*, Ol., which causes serious injury to the heart leaves of young trees, but rarely damages old ones. It is abundant near distilleries, where it breeds in heaps of waste. *Coptotermes truncatus*, Wasm., is the most destructive termite in the Seychelles. In addition to destroying the timber of houses, it attacks the dead wood of *Eucalyptus citriodora*, from which it bores into the living wood; when this occurs below the soil level, the roots may be completely destroyed and the tree killed. A nest was found in a hollow coconut trunk, with borings ramifying into the living wood. In addition to infesting the seeds of *Cajanus cajan* (*indicus*) so severely that no crop is obtained [cf. *R.A.E.*, A **27** 335], *Etiella behri*, Zell., attacks lima beans and the cover crop, *Crotalaria* sp. The larvae hollow out the seeds and generally pupate in the pod; the adults emerge after 18 days. Parasitism by *Eupelmus malgascius*, Masi, the Ichneumonid, *Tarytia minuta*, Morl., and an unidentified Braconid is fairly common among larvae feeding on *Crotalaria*, but not among those on *C. cajan*. The Cecidomyiid, *Megommata seychelli*, Barnes [**28** 214], the larvae of which feed principally on the egg-masses of *Pulvinaria* sp., is abundant on Mahé Island wherever the host occurs. The Coccinellid, *Pharoscymnus* (*Sticholotis*) *madagassus*, Weise, is predacious on *Aulacaspis* (*Diaspis*) *pentagona*, Targ., on papaya, but, though common, it has not been observed feeding on any of the numerous Coccids that occur on coconut.

VESEY-FITZGERALD (D.). **Progress of the Control of Coconut-feeding Coccidae in Seychelles.**—*Bull. ent. Res.* **32** pt. 2 pp. 161–164. London, 1941.

An account is given of the progress made during 1940 by imported predators in the control of Coccids on coconut in the Seychelles [cf. *R.A.E.*, A **29** 323], and the incidence of *Ischnaspis longirostris*, Sign., *Pinnaspis buxi*, Bch., *Chrysomphalus ficus*, Ashm., and *Eucalymnatus tessellatus*, Sign., in five districts is shown in tables. There was a marked reduction in the numbers of all four species, and, in the case of at least the first two, this is attributed largely to the activities of the Coccinellid, *Chilocorus nigritus*, F., which was introduced in 1938 from Coimbatore, and which is predacious on *Coccus* (*Lecanium*) *viridis*, Green, on coffee in South India. Of a consignment of 66 adults, 40 arrived alive; they fed readily on the papaw scale [*Aulacaspis pentagona*, Targ.], but since it was rare when they arrived, they were enclosed in bags on bamboo stems, on which a Coccid was common, in coconut plantations until a generation had been reared, when the bags were removed and the adults allowed to disperse. They migrated to the palms and attacked all the species of Coccids present on them. *C. nigritus* was firmly established in 1939, and by 1940 had become the most abundant predator. It feeds readily on *P. buxi*, against which *C. distigma*, Klug, was not very effective, and possibly also attacks *E. tessellatus*, on which it is reported to feed in South India.

There was again no indication that the numbers of any species of Coccid were increasing as a result of reduced interspecific competition.

Other predators introduced during 1938 were *C. politus*, Muls., from Mauritius and *Rodolia (Vedalia) cardinalis*, Muls. [cf. **28** 330] from South Africa. Adults of the former fed on *I. longirostris* on *Raphia*, but died without ovipositing. *Rodolia* was reared for several generations on *Icerya seychellarum*, Westw., and then liberated on *Casuarina* infested by this Coccid, but no recoveries were made, and breeding was discontinued.

SIMMONDS (H. W.). **Biological Control of the Rhinoceros Beetle** (*Oryctes rhinoceros* L.), 1939.—*Bull. Dep. Agric. Fiji* no. 21, 30 pp., 1 pl., 2 figs., 10 refs. Wellington, N.Z., 1941.

This paper comprises a detailed account of the investigations carried out in Malaya, Java, Mauritius, Madagascar and Zanzibar in 1939, with a view to introducing natural enemies for the control of *Oryctes rhinoceros*, L., on coconut in Samoa, and the successful shipment to Samoa of the Carabid, *Catascopus facialis*, Wied., from Malaya and of *Scolia oryctophaga*, Coq., from Mauritius and Madagascar [R.A.E., A **29** 148]. The author also discusses the habits and life-history of *O. rhinoceros* and the history of its spread, and the habits of Scoliids, their value in controlling *Oryctes* spp. and the methods used in transporting them, and records that cultures of *Metarrhizium anisopliae*, received in Samoa from Java, were used to inoculate breeding traps against *O. rhinoceros* [cf. **25** 299; **26** 434]. Larvae placed in the traps became infected, but the method has the disadvantage that regular provision and supervision of artificial breeding traps is required to maintain the efficiency of the fungus.

BROWNE (F. G.). **The economic Importance of Malayan Ambrosia Beetles**.—*Malay. Forester* **10** no. 2 pp. 59–68, 3 refs. Kuala Lumpur, 1941.

Though few of the numerous insects that are injurious in the forests of the Malay Peninsula are outstanding pests, certain species may become of increased importance with the conversion of the forests to a more homogeneous type. An attempt is therefore made in this paper to assess the present relative importance and the chances of mass increase of the Scolytids and Platypids, which, in addition to direct injury, may cause damage indirectly by carrying fungi or by creating conditions favourable for infestation by other insects, notably termites. The abundance, food-plants and gallery systems of various species and the size and condition of the timber attacked are discussed, and a list of the 148 species recorded from Malaya, with their food-plants and notes on their abundance and economic importance and the type of material infested, is appended.

DE SANTIS (L.). **Lista de himenópteros parasitos y predadores de los insectos de la República Argentina**.—*Bol. Soc. brasil. Agron.* **4** no. 1 repr. 66 pp., 128 refs. Rio de Janeiro, 1941.

This list of the Hymenoptera recorded as predacious or parasitic on insects in Argentina up to the end of 1939 is arranged under the hosts, of which there are more than 200. The scientific name of each insect (preceded, if it has one, by its popular name) is followed by the names

of its parasites, hyperparasites and predators, showing the years in which they were described, and references to the bibliography. Indices to the hosts and to the parasites and predators are appended.

The author states that the genus *Passalida*, Brèth., is congeneric with *Amitus*, Hald.; that *Amitus blanchardi*, De Santis [R.A.E., A 25 801] is a synonym of *A. (P.) spiniferus*, Brèth.; and that *Coccophagus heteropneusticus*, Comp. [28 374] is a synonym of *C. (Onophilus) caridei*, Brèth. [6 428]. New host records for parasites in Argentina comprise *Asaphes vulgaris*, Wlk., from *Aphis nerii*, Boy.; *Aspidiotiphagus citrinus*, Craw, from *Chionaspis (Unaspis) euonymi*, Comst.; *Ablerus molestus*, Blanch., from *Coccus (Lecanium) hesperidum*, L.; *Apanteles alexanderi*, Brèth., from *Argyrotoxa semipurpurana*, Kearfott; *Pachyneuron syrphiphagum*, Brèth., from *Allograpta exotica*, Wied.; *Aphidius platensis*, Brèth., from *Anuraphis schwartzi*, Börn.; *Aphelinus mali*, Hald., from *Aspidiotus hederæ*, Vall.; *Aspidiotiphagus lounsburyi*, Berl. & Paoli, from *Aonidiella aurantii*, Mask.; *Eretmocerus corni*, Hald., from *Lepidosaphes beekii*, Newm.; *Metaphycus (Aphycus) flavus*, How., from *Eriococcus jorgenseni*, Morr.; *Bassus (Diplazon) laetatorius*, F., from *Cydia (Laspeyresia) molesta*, Busck; *Perisierola nigrifemur*, Ashm., from *Platyedra (Pectinophora) gossypiella*, Saund.; and *Encospilus purgatus* var. *arcuatus*, Felt, from *Alabama argillacea*, Hb. The author states that the last eight of these records were made by Blanchard.

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